

The AMSAT[®] Journal

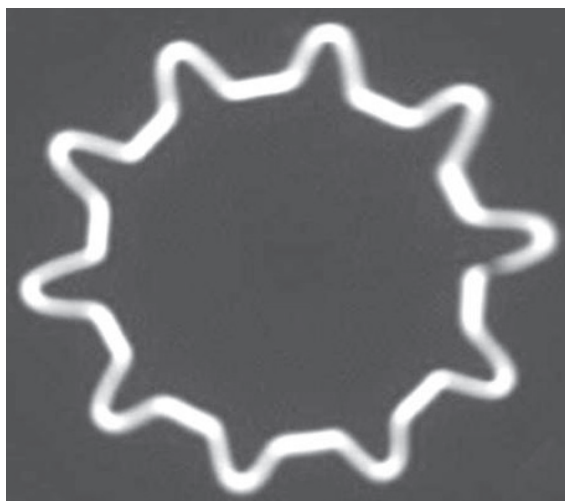


Editor-in-Chief:
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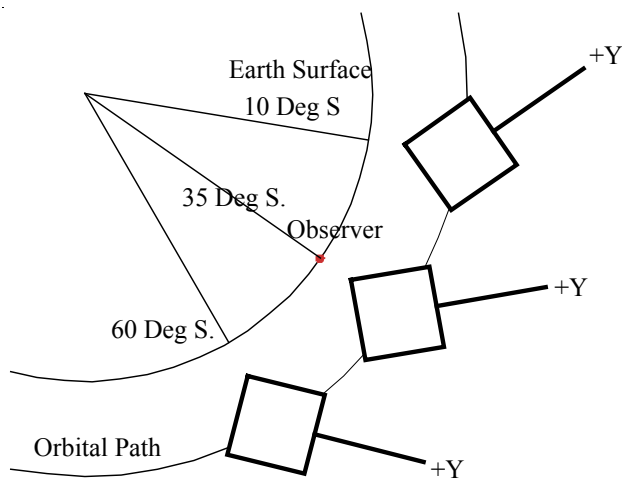
Assistant Editor:
Bill Hook, W3QBC

Volume 31, Number 4

July/August 2008



Do Not Adjust Your TV



Attitude Adjustment

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Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

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AMSAT Announcements

2008 AMSAT Annual Meeting and Symposium

"The 2008 Harry Yoneda, JA1ANG (SK), AMSAT Space Symposium" will be held October 24-26, 2008 in Atlanta (Buckhead), GA. The AMSAT BOD meeting preceeds the Symposium. This is a family friendly location in the exciting Buckhead area of Atlanta. Only 1.5 blocks to the best shopping in Atlanta and to the MARTA subway system. You can even ride MARTA from the airport. Nicely appointed rooms at the Atlanta Buckhead Doubletree Hotel. Information can be found at <http://www.amsat.org/amsat-new/symposium/2008/index.php>. There will be a Sunday trip to the Georgia Aquarium, the world's largest aquarium. Watch in awe as the huge whale sharks glide through the tank. Plan on being there!

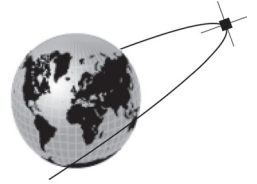
AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





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AMSAT's Eagle Project, Part 2

In the last issue of the Journal I described the evolution of AMSAT's Eagle project. The primary goal of Eagle is to put a communications payload into high earth orbit. This project has seen various important changes over time based on the evolution of our understanding of orbital dynamics, our desire to reach out to a wider audience with new technology, launch costs and new launch opportunities.

Unfortunately, AMSAT has experienced difficulty managing these changes. There are various reasons for this including conflicting views of the end goal with the AMSAT board and officers, the introduction of new volunteers with strong views of their own, inadequate communication with the existing users of ham satellites, only some of whom are AMSAT members, and inadequate leadership by your president and his executive team. The most visible result of these problems was a "meltdown" of the engineering department in June and July of this year. I take full responsibility for these failures and I apologize to the AMSAT membership for them.

I think, however, there is a silver lining in all of this. The opportunity to launch an AMSAT "rideshare" payload attached to a large commercial satellite still exists. The fundamental design decisions made for the Eagle mission payload in 2004 are still valid for this geosynchronous HEO mission. In my opinion this leaves us with three main concerns. First, we must fit the mission limitations provided to us by the commercial satellite designers, especially as regards the available space and location of that space on their satellite. Second, we must minimize the parameters that would affect cost, particularly mass and antenna size. Third, we will need outside funding to make up the bulk of the launch costs so a mission must be planned that meets the needs of such funding sources as well as our own.

It is this last point that has created controversy in recent months. AMSAT's board and other interested AMSAT members have renewed the discussion about what mission parameters are important to assure adequate funding for Eagle's launch while simultaneously meeting the needs and desires of our members. There is another group I have been trying to consider in this discussion which is the hundreds of thousands of other hams who should be operating satellites but

don't for a variety of reasons. I have long believed that the Advanced Communications Payload (ACP) would make ham satellite communication available to this group.

Unfortunately, the combination of the engineering department's meltdown, my inability to devote full-time effort to AMSAT and differences with the board over priorities has led me to the conclusion that I must step aside and give someone else the opportunity to move AMSAT forward. Thus, this will be my last Apogee View as I will not offer my name for the position of president at the next board meeting in October. I am taking this action in what I believe to be the best interests of AMSAT and you, the members. I will continue to serve on the board and I will devote my newly found free time to engineering activities that I hope will be of benefit to AMSAT in the future, especially on the SuitSat and Eagle projects.

Thank you all for your support. It has been my honor to serve you for the past four years.

Remember that you can contact your AMSAT board members and officers through the links on the AMSAT Web page (www.amsat.org, go to "About AMSAT" then "Our Leadership Team").

73,

Richard M. Hambly, W2GPS
AMSAT President



A Circular Sweep Frequency Calibrator

John M. Franke, WA4WDL jmfranke@cox.net (AMSAT #10211)*

Knowing what frequency you are monitoring or transmitting on is very important, both for the success of the contact and for meeting the legal requirements set down by the FCC. One technique that has been popular for decades is to use a 100 kHz crystal oscillator as a harmonic generator/calibrator. But, how accurate is the 100 kHz oscillator? The 100 kHz oscillator is calibrated by “zero-beating” its harmonics with transmissions from WWV. However, getting down to a beat note of 1 Hz or less at 5 MHz is not easily done by ear. An error of 1 Hz at 5 MHz represents an uncertainty of 0.2 parts per million (ppm). In the past, this level of accuracy would have been sufficient. But, as operations, particularly for satellites, have moved higher in frequency, the need for higher accuracy has grown. At 10 GHz, the same error would be 2 kHz. However, using the 10 kHz signal from a Jupiter GPS receiver and a simple oscilloscope adapter can allow you to easily zero-beat that calibration signal to 0.001ppm or better. An accuracy of 0.001ppm would translate to an error of only 10 Hz at 10 GHz.

I was fortunate to purchase a General Radio model 1109 comparison oscilloscope through an auction. A GR 1109-B is shown in Photo A. General Radio used the GR 1109-A display as part of their Type 1105-

be used with almost any X-Y oscilloscope. The GR 1109 used a special cathode ray tube, a 3DP1, which is similar to common CRTs except for one feature, an electrode in the middle of the screen passing back along the longitudinal axis of the CRT, see Photo B. The electrode permits radial deflection of the beam. Aircraft radio altimeters were one of the primary applications for the CRT. The most common radio altimeter CRT indicator was the I-152. A circle was displayed on the CRT. One pass around the circle represented the range of the radio altimeter. The sweep was synchronized with the transmitted pulse occurring when the sweep was at the top of the circle. Received echoes deflected the beam outward producing a blip corresponding to the aircraft altitude.

The GR 1109 can be thought of as an X-Y oscilloscope with a phase shift network between the two channels and having a third radial deflection input. The GR 1109 generates circles of different externally supplied frequencies by generating two signals ninety degrees out of phase and applying them to the normal CRT deflection plates. GR 1109 is designed for 60 Hz, 100 Hz, 1 kHz, and 10 kHz sweep frequencies. With no trigger or sawtooth circuits, the vacuum tube count is only seven, including the CRT. I did replace two of the tubes with solid-state diodes mounted in tube bases. By

the way, the high voltage rectifier from a discarded microwave oven makes a great replacement for a 2X2A. With the solid-state devices, the power drain for the GR 1109 is approximately 20 Watts. The 10 kHz rate is what first interested me. A Jupiter GPS navigation receiver outputs a precision 10 kHz when locked to four or more GPS satellites. While the 10 kHz signal is not as accurate as signals from a precision timing GPS receiver disciplining a crystal oscillator, accuracies better than 0.001ppm are normal. I derived 1

kHz and 100 Hz signals from the same 10 kHz signal. The GR 1109 gets a 60 Hz sweep signal from the power line.

The block diagram of the 10 kHz, 1 kHz and 100 Hz generator is shown in Figure 1. The 10 kHz signal from the Jupiter receiver is first buffered by a CD4049 CMOS



Photo B; 3DP1 radial deflection CRTs.

inverter. The 10 kHz signal is then split down two paths. One path is to a 10 kHz op amp bandpass filter. The other path is to a CD4518 CMOS dual section decade divider. The decade divider generates the 1 kHz and 100 Hz signals which are each buffered and sent through bandpass filters. I used the Q3 outputs from each of the dividers because of the better output waveform duty ratio (60%). All of three filters have the same Q of 10, so the filter design was simple, see Figure 2. I designed the 10 kHz filter and then simply scaled the timing capacitors for the other two filters. The resistors and capacitors were pulled directly from my supply cabinet. The adjustment potentiometer compensated for any component tolerances. The filter tuning is very smooth and the waveforms are clean. Being bandpass filters, they are ac coupled so there is no dc offset on the input or output signals. The filter outputs are buffered with unity gain op amps. The output amplitudes are approximately 6 Vpk-pk, which is more than sufficient for the GR 1109.

No sooner than the breadboard was completed, I used the system to check the 100 kHz output from a military surplus URQ-10 standard frequency generator I use to drive a digital clock. Because the 100 kHz signal frequency is ten times the 10 kHz



Photo A: General Radio 1109B comparison oscilloscope.

A Frequency Measuring Equipment in the 1950s. The same oscilloscope design was used by the military as part of the Frequency Calibration Set AN/URM-18. The military designation for the oscilloscope is OS-16/URM-18. Later, I will show a circuit that can

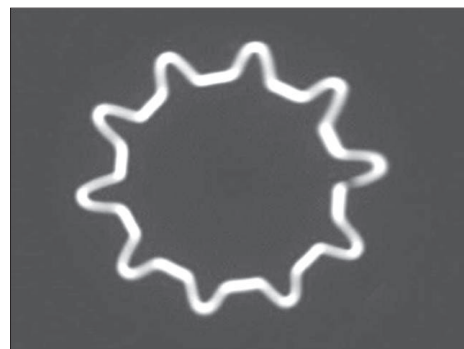


Photo C: Lobed pattern on GR 1109-B, 10 kHz sweep, 100 kHz signal.

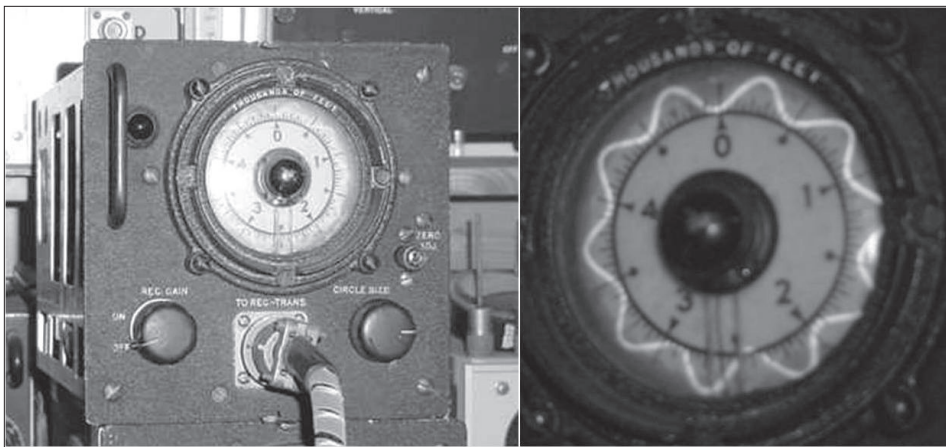


Photo D: I-152-A indicator, 100 kHz sweep, 1 MHz signal.

sweep frequency, ten lobes are produced, see Photo C. If the 100 kHz source is exactly 100 kHz, the pattern would be stationary. If the source is lower than 100 kHz, the pattern slowly drifts CCW and if higher, CW. A drift of one lobe or spoke distance in one second represents an error of 1 Hz or 10 ppm for 100 kHz, a time of 10 seconds represents 0.1 Hz or 1 ppm, a time of 100 seconds represents 0.01 Hz or 0.1 ppm, and a time of 1000 seconds (16 minutes 40 seconds) represents 0.001 Hz or 0.01 ppm. Higher accuracy is obtainable if you just wait for it. There was a 1 lobe CCW drift over a period of roughly 250 seconds. This represents a beat frequency of 0.004 Hz or an error of 0.04 ppm. An error of this magnitude would cause a one second error to my General Radio 1123A synchronometer clock every 289 days, which is approximately the clock error I do observe (one second every 300 days).

I also used a military surplus I-152-A indicator mentioned previously to check a

1 MHz source, see Photo D. The indicator was designed for a circular sweep frequency of 98.356 kHz. The sweep circuits were easily re-tuned to 100 kHz. With the higher sweep rate and source frequency, the same accuracies can be obtained in one-tenth the observation time.

But, lacking these two displays, anyone with an X-Y oscilloscope can make similar measurements. Of course, without the radial deflection electrode, a slightly different tack must be taken. One method used in the 1920s by D. W. Dye was to modulate the CRT high voltage supply and thus vary the deflection sensitivity of the CRT. But there are other techniques. The path I chose is a bit simpler modern version of that used by R. A. Watson-Watt in the 1940s. The first step was to generate the two 10 kHz signals ninety degrees out of phase. This was done as shown in Figure 3. The same filter as before was used to generate a smooth 10 kHz sine wave from the square wave output from a Jupiter GPS receiver. Then, similar

to the GR 1109, a simple two branch RC network using two each series connected .01 mF capacitors and 1.5 K resistors generated a +45 degree and a -45 degree phase shifted signal. The two capacitors have a reactance equal to the resistance of the resistors at 10 kHz. I just grabbed parts from my supply bin and obtained a nice looking circle with no trimming.

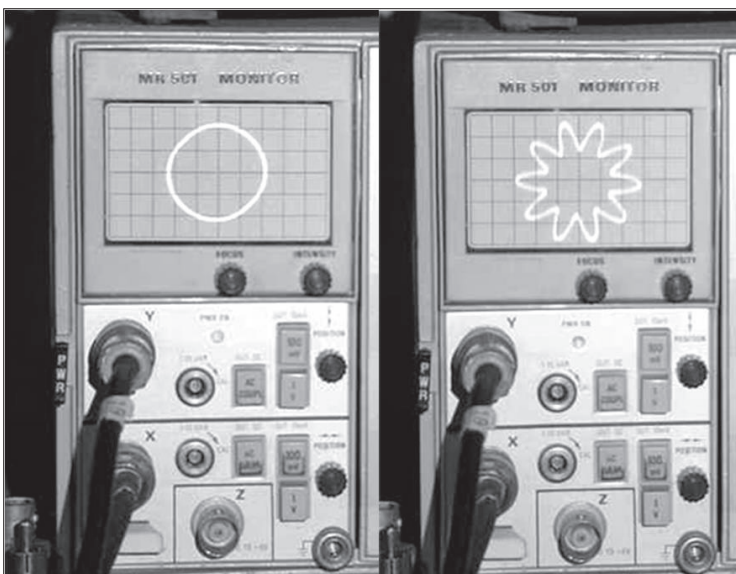


Photo E: MR501 Display without and with signal.

The buffered signals were then passed to two balanced modulators, Figure 4. The two modulators consist of four-quadrant multipliers (Burr-Brown type MPY634KP), which are used to modulate the two 10 kHz signals with the external frequency source. Prior to driving the modulators, the external signal is combined with a dc signal, Figure 5. The level of the dc signal determines the circle diameter and the amplitude of the external source determines the amplitude of the lobes. The outputs from the modulator are amplified and are ready for display on most X-Y oscilloscopes having a deflection sensitivity of 1V/division or greater. Photo E shows the display on a Tektronix MR501 oscilloscope with and without the external signal. This circuit has less distortion for the radial signal than the GR 1109, but the GR 1109 limiting action negates the need for a level adjust control.

Frequencies other than 100 kHz can be checked as long as they are exact multiples of 10 kHz. One frequency that comes to mind is 60 kHz from WWVB, which would generate six equally spaced lobes.

The end result is a nifty, although geeky, display and instrument for calibrating your sources to 0.001ppm. The cost, including the Jupiter GPS receiver is less than a surplus Hewlett-Packard 10811 crystal oscillator and is referenced to atomic sources onboard the GPS satellites. I have made a general purpose circular display using a B & W model 350 audio phase shift network to generate the X-Y signals for frequencies from 250 Hz to over 2000 Hz, but that is another story.

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Schematics begin next page ...



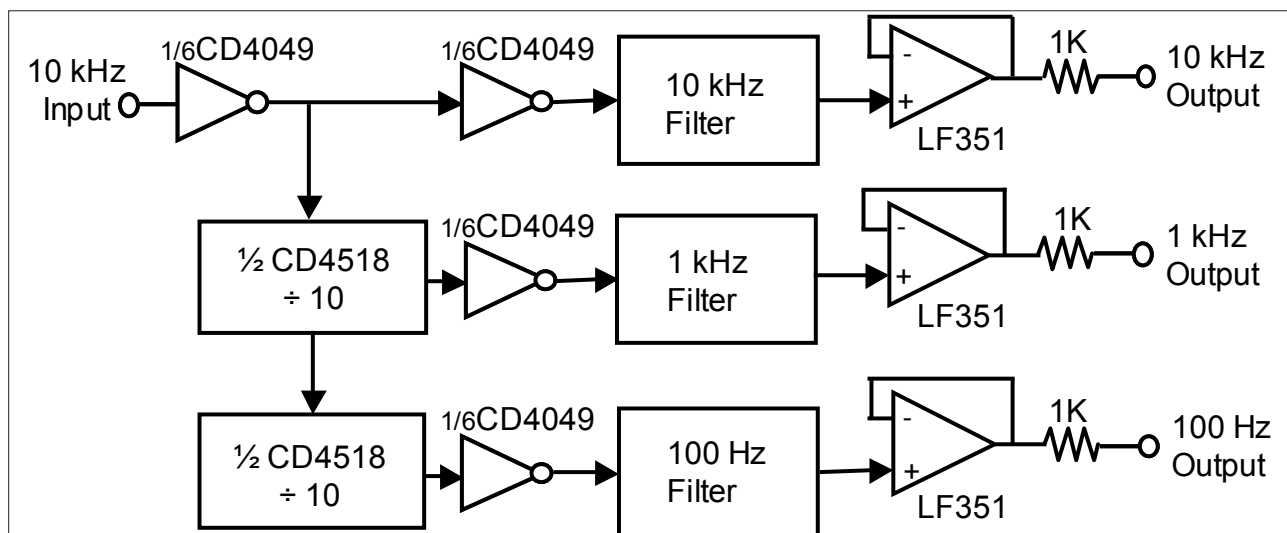


Figure 1: Block diagram of frequency generator.

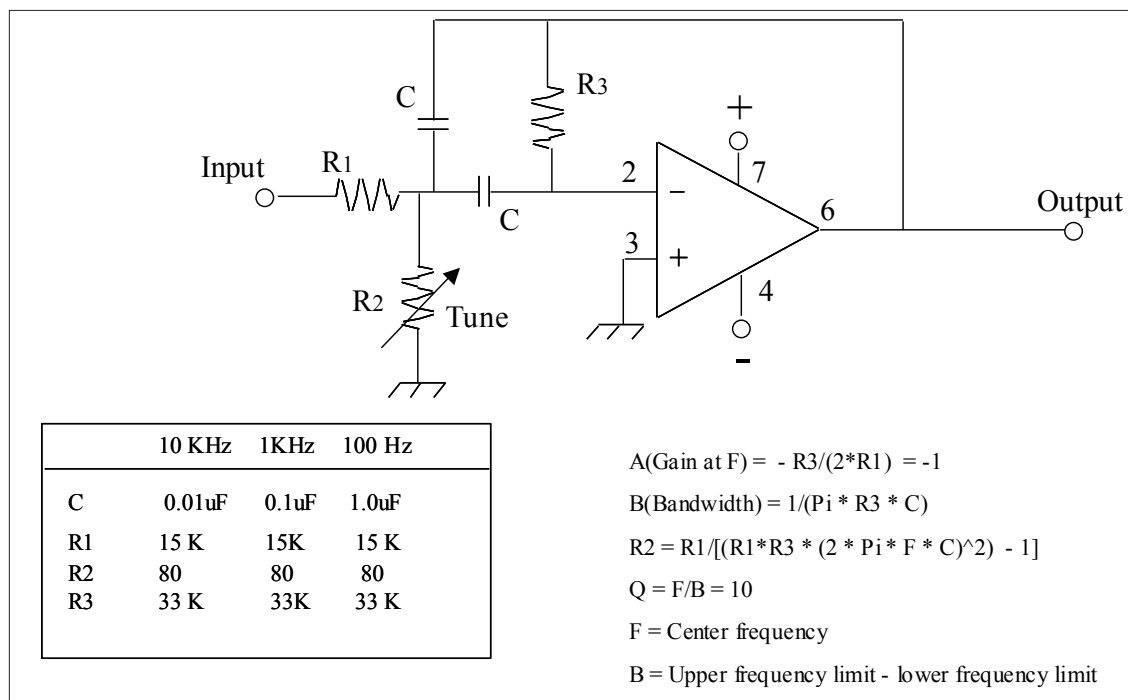


Figure 2: Bandpass filters.

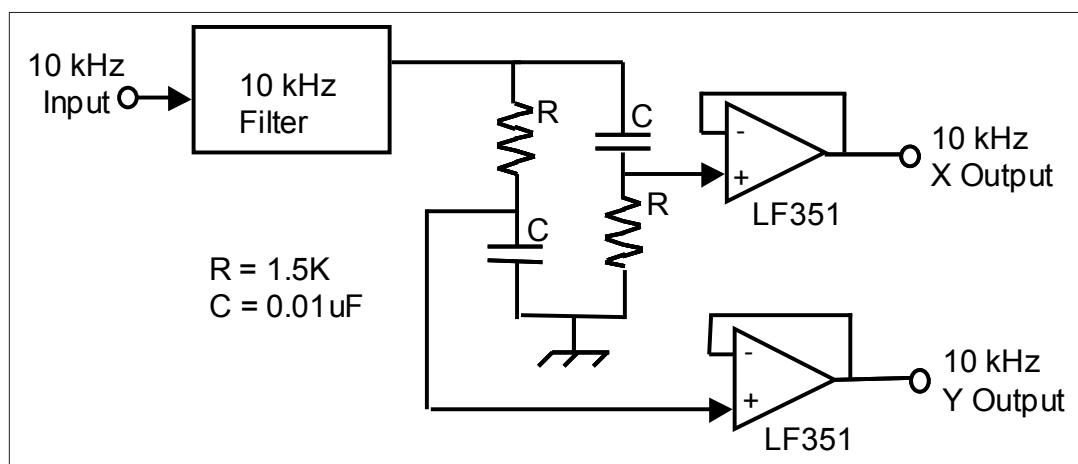


Figure 3: 10 kHz phase shift circuit.

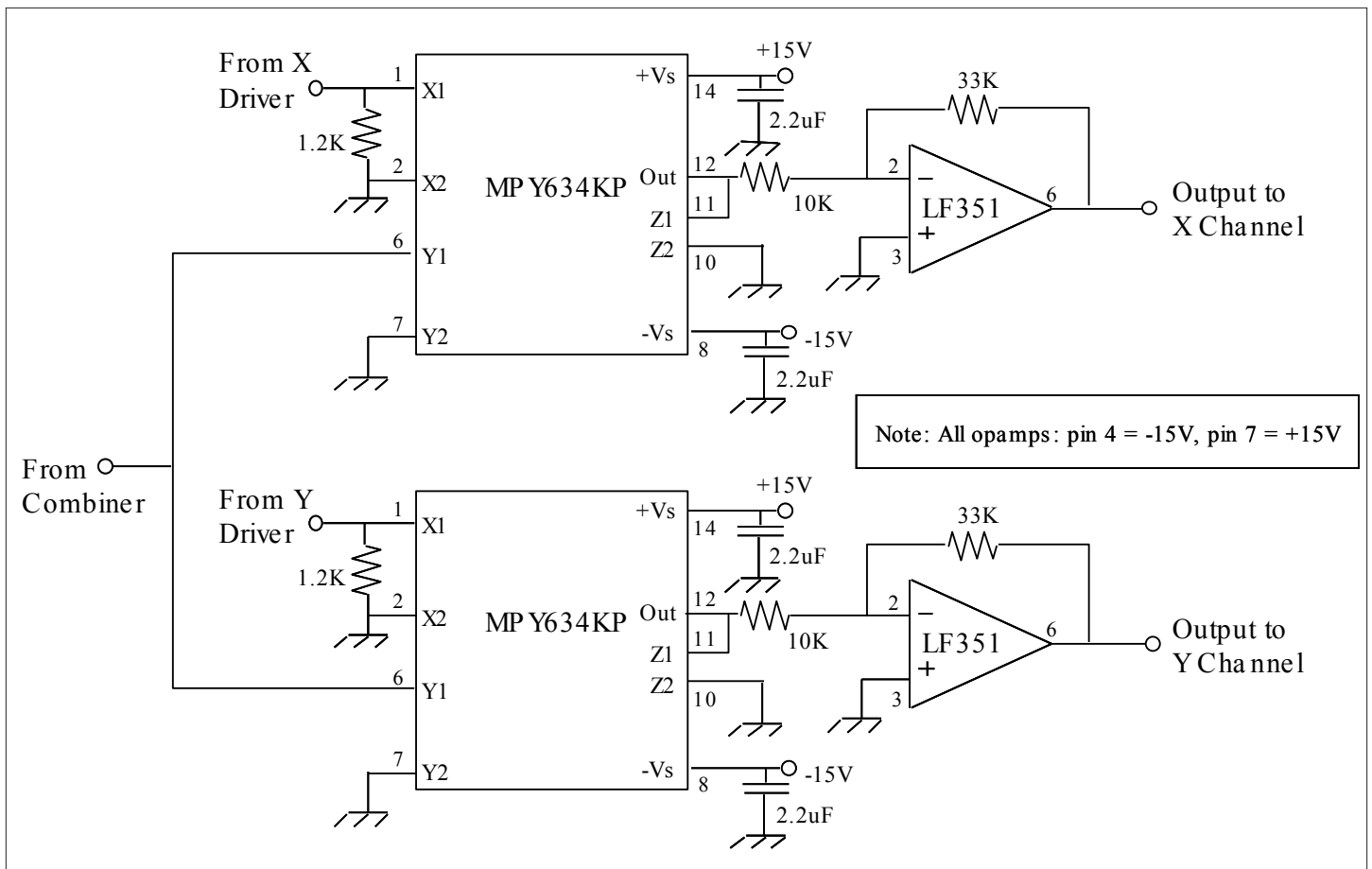


Figure 4: Balanced modulators.

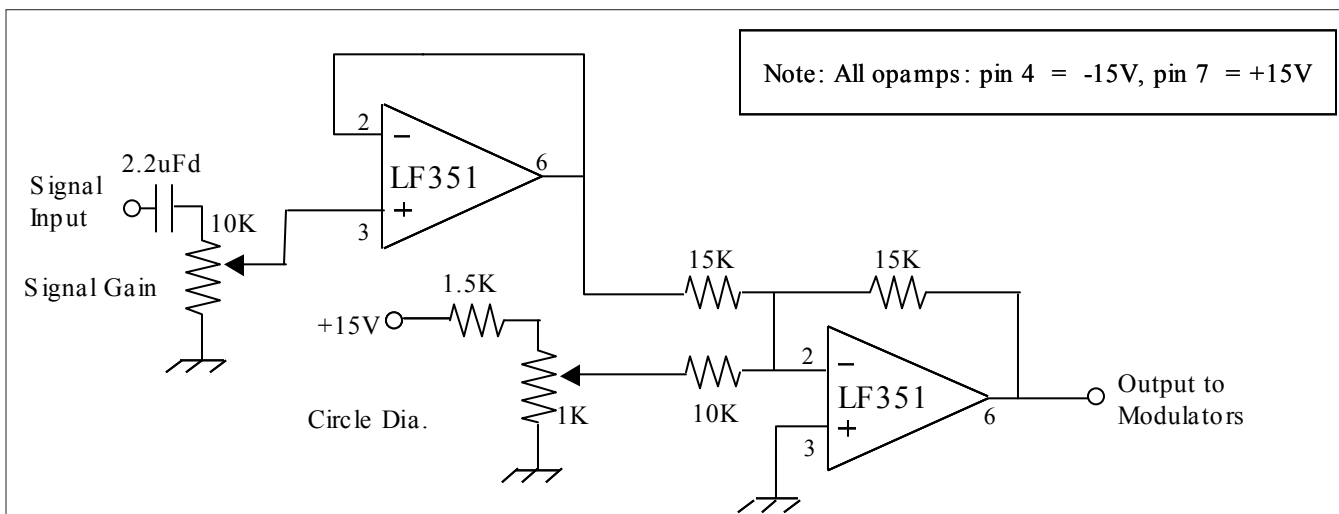


Figure 5: Signal combiner.

A Radio Amateur's Solution for the Attitude Determination of PolySat CP4 (2.1) Using Telemetered Magnetometer Data – Part II

Colin Hurst, VK5HI, cjhurst@bigpond.net.au

Editor's Note: Due to the length of this article and the number of included graphs and plots, this paper is published in two parts. The first part was published in the last issue of The AMSAT Journal.

Appendix A: Magnetometer Info

The magnetometers on CP4 use the Honeywell HMC 1052 Two Axis Magnetic sensor. Jake Dimiceli supplied the following calibration information for the respective magnetometers.

Design Information:

Gain = $5 + (200000 / R1)$

Volt Range = $0.018 * \text{gain}$

Gauss Range = $(6 / \text{volt range})$

A = gauss range / 127.5

B = $-A * (\text{center value})$

y = $A * x + B$ (where y is the converted mag reading)

Calibration Data

The resistor value for each side panel for CP4 are: 330,330,330,330,360 for the Front, Right, Bottom, Left, and Top panels respectively (for both mags on a panel). The center values for each side panel for CP4 are: [132,111], [147,132], [124,121], [128,128], [116,125] for [Mag A, Mag B] on the Front, Right, Back, Left, and Top panels respectively.

Decoding of the Telemetered Magnetometer Data

I used the above information to derive the following formula to convert the telemetered values to milli-Gauss. (Coded for MS Excel Visual Basic):

Function Convert_CP(nIndex As Integer, nByte As Integer) As Double

'Revised 25th June 2007

Select Case nIndex

Case 1:

Convert_CP = nByte * 4.278428 - 564.753

Case 2:

Convert_CP = nByte * 4.278428 - 474.906

Case 3:

Convert_CP = nByte * 4.278428 - 628.929

Case 4:

Convert_CP = nByte * 4.278428 - 564.753

Case 5:

Convert_CP = nByte * 4.278428 - 530.525

Case 6:

Convert_CP = nByte * 4.278428 - 517.69

Case 7:

Convert_CP = nByte * 4.278428 - 547.639

Case 8:

Convert_CP = nByte * 4.278428 - 547.639

Case 9:

Convert_CP = nByte * 4.278428 - 541.013

Case 10:

Convert_CP = nByte * 4.274528 - 582.988

End Select

End Function

Appendix B:

Using the World Magnetic Model WMM-2005

I downloaded the "C" Version of the model and incorporated it and Plan 13 into a program using Visual C++ 6. The methodology of the program was outlined under the heading Methodology. The following is an extract from the WMM-2005 Manual (noted under Acknowledgements) describing the components of the geomagnetic field vector.

"The geomagnetic field vector, B, is described by 7 elements. These are: the orthogonal components X (northerly intensity), Y (easterly intensity), and Z (vertical intensity, positive downwards), total intensity F, horizontal intensity H, inclination (or dip) I (the angle between the horizontal plane and the field vector, measured positive downwards), and declination (or magnetic variation) D (the horizontal angle between true north and the field vector, measured positive eastwards)."

The Earth's Total Intensity

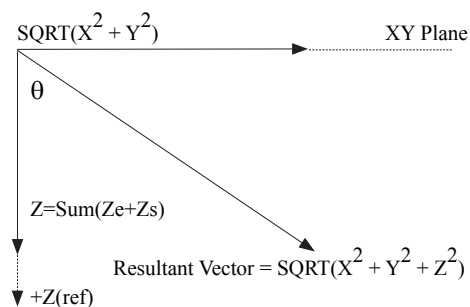
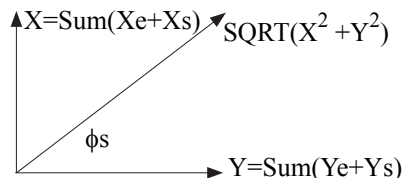
$$F = \text{SQRT}(X^2 + Y^2 + Z^2)$$

For the purpose of analysis the Total Intensity recorded by CP4's Magnetometers should also equate to the Earth's Total Intensity Field F.

Preliminary analysis highlighted that the respective magnitudes were in some instances significantly different. This led me to identify the non-linearity in the magnetometers, noted above under Magnetometer Accuracy.

Calculation Process

To calculate the angle ϕ subtended by the Satellites X axis (Xs) relative to True North is equal to ϕ s - Declination D, where ϕ s = $\arccos(X \div \text{SQRT}(X^2 + Y^2))$.



To calculate the off-pointing angle θ subtended by the Resultant Vector relative to the Magnetic Vector $+Z$ is equal to $\theta = \arccos(Z \div \text{SQRT}(X^2 + Y^2 + Z^2))$.

Calculated Example

From the 24th May 2007 data we have the following parameters:

Telemetered RTC Time is 14:41:14
=>21:41:14 UTC.

Sequence Number = 26378

The orbital parameters using the Plan13 module defined CP4 as having the following:

Slat = 31.4 North, Slon 196.5 East, Height 669952.9 kilometers

From the Magnetic Model the following parameters were derived for the above orbital parameters. The unit nT is nanoTesla.

F = 29236.8 nT, X = 19283.2 nT, Y = 3502.2 nT, Z = 21695.3 nT and D = 10.29 Deg

The telemetered magnetometer data from CP4 is as follows:

X = -19054.2 nT, Y = 14831.9 nT and Z = -2946.6 nT.

Hence the following calculations:

Check for error ratio, but first confirming the relationship of F, X, Y and Z.

F [earth] = 29236.8 nT which is the value of F from the magnetic model.

$$F[\text{cp4}] = \text{SQRT}((-19054.2)^2 + (14831.9)^2 + (-2946.6)^2) = 24325.5 \text{ nT}$$

The error ratio $F[\text{earth}] / F[\text{cp4}] = 29236.8 / 24325.5 = 1.2019$

Correcting the telemetered values by this factor of 1.2019 we have

X=-22901.3 nT, Y=17826.5 and Z=-3541.5 nT.

$$\text{Cross check of revised } F[\text{cp4}] = \text{SQRT}((-22901.3)^2 + (17826.5)^2 + (-3541.5)^2) =$$

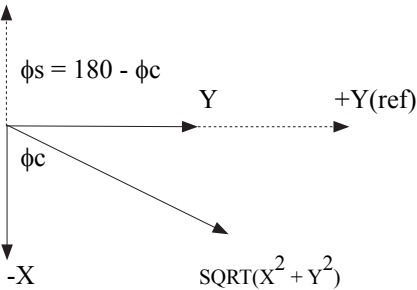


29236.8 nT.

Hence the value of $X = -19283.2 + 22901.3 = -3618.1$ nT

$Y = 3502.2 + 17826.5 = 21328.7$ nT and $Z = 21695.3 - (-3541.5) = 18153.8$ nT

To calculate the angle ϕ_s subtended by X_s relative to $+X(\text{ref})$



$$SQRT(X^2 + Y^2) = SQRT((-3918.1)^2 + (21328.7)^2) = 21633.4 \text{ nT}$$

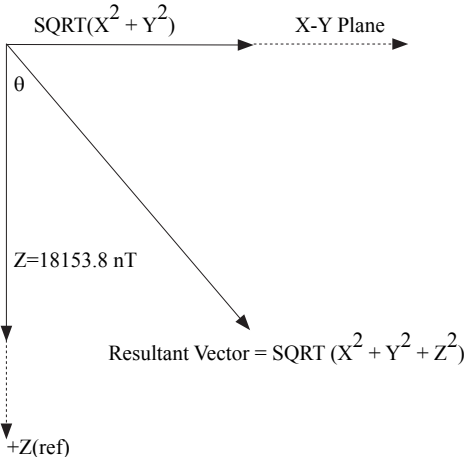
$$\phi_c = \arccos(X \div SQRT(X^2 + Y^2)) = \arccos(-3618.1 \div 21633.4) = 80.37 \text{ Deg.}$$

$$\phi_s = 180 - 80.37 = 99.63 \text{ Degrees}$$

The angle ϕ subtended by the X axis of CP4 and True North is equal to $\phi_s - D$

$$= 99.63 - 10.29 = 89.34 \text{ Degrees}$$

To calculate the off-pointing angle θ subtended by the $+Z(\text{ref})$ axis and the Resultant Vector is as follows.



$$\text{Resultant Vector} = SQRT(X^2 + Y^2 + Z^2) = SQRT((-3618.1)^2 + (21328.7)^2 + 18153.8^2) = 28241.1 \text{ nT}$$

$$\theta = \arccos(Z \div SQRT(X^2 + Y^2 + Z^2)) = \arccos(18153.8 \div 28241.1) = 50.0 \text{ Degrees.}$$

Please Note

The mathematical solutions for ϕ_s are different for each quadrant. The equations provided only apply to the examples shown viz: $+X$, $+Y$ and $+Z$.

These values of ϕ and θ are shown on the graph detailed in Figure 1 (Part I - Ed.), as ϕ and θ respectively. The image below is an enlarged snapshot of the respective points from that graph.

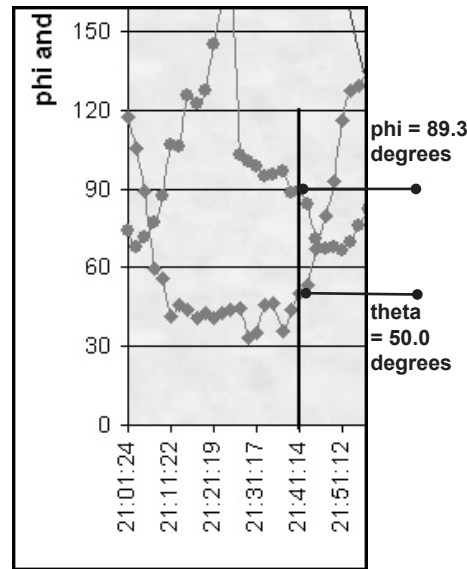


Figure 12: Magnified view.

Appendix C: Introduction

The graph in Figure 12 is based on observations from the QTH of VK5HI recorded on the 14th and 15th June 2007.

Figure 12 highlights the elevation of the satellite and the S/N Ratio of the downlinked signal at 1-minute beaconing intervals. The Larger dots on the S>N Ration curve identify those telemetered frames that were **not** decoded, whereas the smaller dots identify successfully decoded frames. Analyzing the recorded .wav file allowed the derivation of the S/N Ratio's.

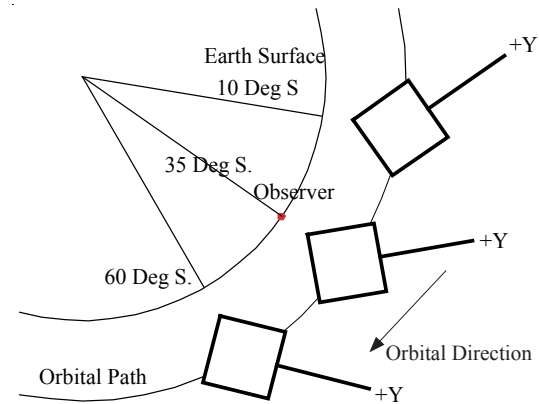
Both the passes highlighted were to the east of VK5HI, with no physical obstructions to affect received signals.

An observation from the graph in Figure 1 (Previous issue - Ed.) is that there may be a level of nutation in the order of 25 degrees of the $Y+$ axis.

Observations

The diagram below is a diagrammatic view of the attitude of CP4 traversing the Southern Hemisphere in the range 10 Degrees South to 60 Degrees South Latitude.

This is the maximum range of coverage available to VK5HI.



Considering the orbit recorded on 15 June 2007 from 0034 UTC to 0047 UTC, which was ostensibly a direct overhead pass the performance shown on the graph below, can be directly related to the diagram above.

At AOS (Acquisition of Signal) the attitude of CP4 is such that the antenna is shielded from the observer. As CP4 approaches TCA (Time of Closest Approach) the shielding becomes less and the received S/N Ratio gradually increases. Decode-able telemetered frames are available through to LOS (loss of signal).

Analyzing the previous low elevation orbit recorded from 2300UTC to 2309 UTC 14th June 2007, the results require closer scrutiny.

At AOS, CP4 was due east of the observer (VK5HI) consequently the antenna was not shielded, resulting in decode-able telemetered frames. The degradation of the downlink performance approaching LOS may be attributable to a combination of the following.

- The effects of nutation at decreasing elevation relative to the observer
- Increasing range distance
- Atmospheric and Ionospheric Losses

Appendix D: Explanation of Rotational Speed Derivation

The calculation of the rotational speed is as follows.

The incremental difference between each calculated value of **phi** is stored in an array, on the basis of ranges of 30 degrees, eg: 0 to 30, 30 to 60, through to 330 to 360 degrees.

The array is then analyzed to establish two adjacent boundaries with the maximum number of counts per range, eg: 90 to 120 and 120 to 150 degrees.

The values of those falling within the two



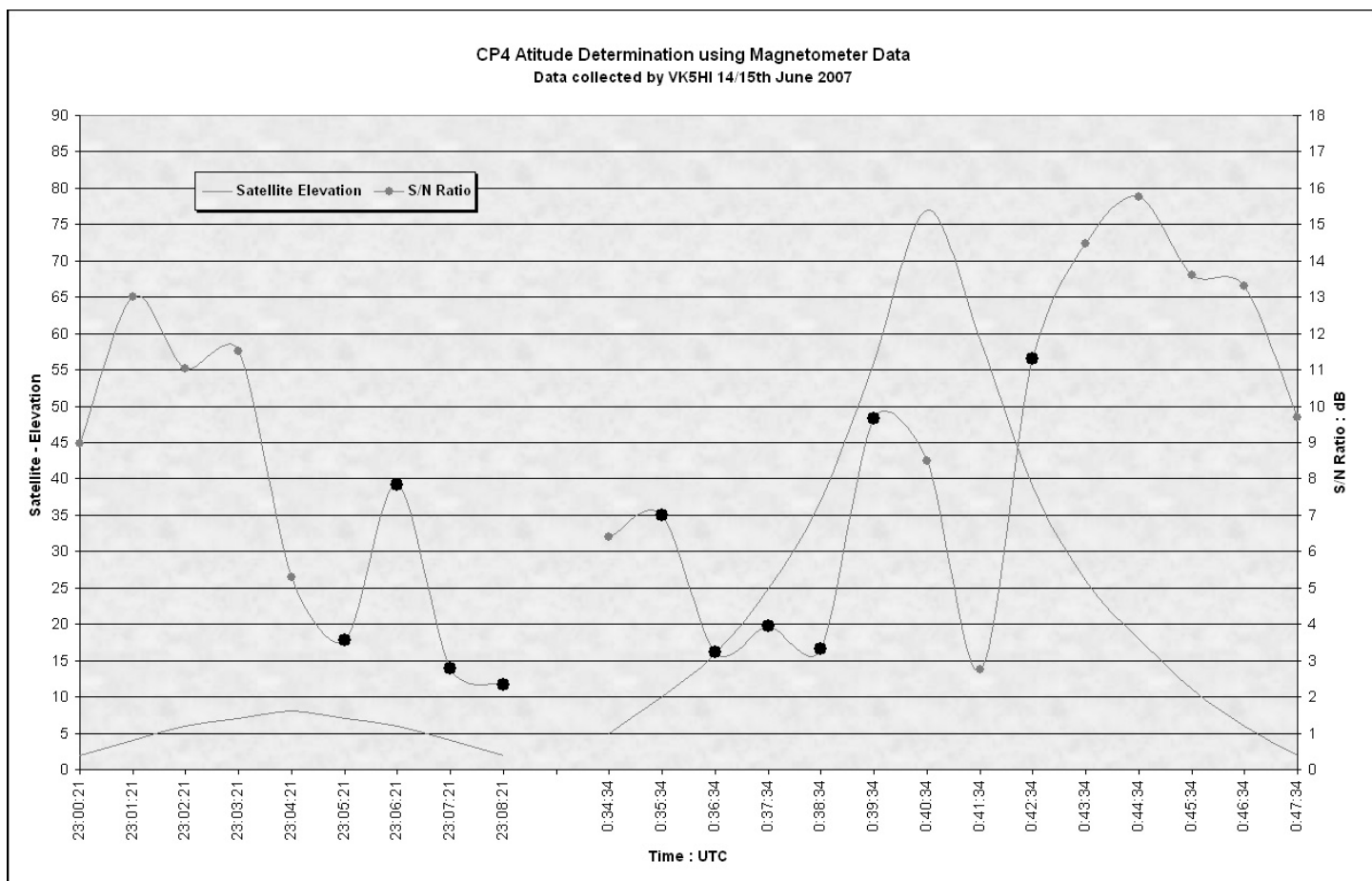


Figure 13: Appendix C: Confirmation of attitude by observation.

adjacent ranges are passed into another array and the averaged value of all values is calculated.

A final pass over the array filters all values in the range greater than $0.95 \times \text{Averaged Value}$ and less than $1.05 \times \text{Averaged Value}$ and a

Final Averaged Value obtained.

The graph in Figure 10 [Previous issue - Ed.] has been tabulated using the information in the table below.

The left-most Y axis in the graph is the

Number of Values per Speed Range, columns 2, 3 and 4 and the right most Y axis is the % Values, columns 5, 6 and 7 in the table below.

The table on the top of the next page summarizes the processing statistics.

Number of Telemetered Values				212	224	1294
Date -->	24May2007	12June2007	21June2007	24th % Values	12th % Values	21st % Values
180-210	0	0	0	0.0%	0.0%	0.0%
210-240	0	0	0	0.0%	0.0%	0.0%
240-270	0	0	1	0.0%	0.0%	0.1%
270-300	1	0	1	0.5%	0.0%	0.1%
300-330	2	0	3	0.9%	0.0%	0.2%
330-360	97	106	600	45.8%	47.3%	46.4%
0-30	93	118	674	43.9%	52.7%	52.1%
30-60	14	0	8	6.6%	0.0%	0.6%
60-90	4	0	4	1.9%	0.0%	0.3%
90-120	0	0	3	0.0%	0.0%	0.2%
120-150	1	0	0	0.5%	0.0%	0.0%
150-180	0	0	0	0.0%	0.0%	0.0%
Check	212	224	1294			

The averaged filtered values are used to calculate the Rotational Speed knowing the telemetered time increment.

- Speed calculation 24th May Avg Rotation (degrees) / Time Inc (seconds) * 60/360 (revs per minute)
 $359.41 / 119 * 60 / 360 = 0.503 \text{ rpm}$ (1 minute 59 second sampling)

- Speed calculation 12th June
 $360.33 / 29 * 60 / 360 = 2.070 \text{ rpm}$ (29 second sampling)

24May 2007	12June2007	21June2007	
190	224	1274	Values averaged
161	219	1254	Values averaged but filtered (0.95 to 1.05 of Averaged Value)
359.1	360.22	360.14	Averaged rotation per telemetered time increment
359.41	360.33	360.19	Averaged filtered (0.95 to 1.05) per telemetered time increment

Processing statistics

- Speed calculation 21st June 360.19 / 29 * 60 / 360 = 2.070 rpm (29 second sampling)

The code used (Coded for MS Excel Visual Basic) is as follows.

This subroutine expects contiguous telemetered frames. The telemetry of the 21st June was not totally contiguous, but the small number of disjoints were filtered out.

Code Listing:

Sub Obtain_Rotation(strSheet As String, nWriteCol As Integer, nReadCol As Integer)

‘updated 5th July 2007

```
Dim nRange(12) As Integer, nX As Integer,
nRows As Integer
Dim dVal As Double, dVal1 As Double, dVal2
As Double, dTotal As Double
Dim dMax1 As Double, dMax2 As Double
Dim dAverage As Double, dValArray() As
Double
Dim nCounter As Integer, nCounter1 As Integer
Dim nMin As Integer, nMid As Integer, nMax
As Integer
Dim bExtended As Boolean
Dim nCount As Integer
nRows = Get_Rows(strSheet, 3)
ReDim dValArray(nRows)
Worksheets(strSheet).Select
For nX = 3 To nRows - 1
    dVal1 = Cells(nX, nReadCol)
    dVal2 = Cells(nX + 1, nReadCol)
    dVal = dVal1 - dVal2
    If dVal < 0 Then dVal = dVal + 360
    If dVal > 360 Then dVal = dVal - 360
    Cells(nX, nWriteCol).Value = dVal
    dVal = Cells(nX, nWriteCol)
    If Not IsEmpty(dVal) And
    IsNumeric(dVal) Then
        If dVal >= 0 And dVal < 30 Then
            nRange(1) = nRange(1) + 1
        If dVal >= 30 And dVal < 60 Then
            nRange(2) = nRange(2) + 1
        If dVal >= 60 And dVal < 90 Then
            nRange(3) = nRange(3) + 1
        If dVal >= 90 And dVal < 120 Then
            nRange(4) = nRange(4) + 1
        If dVal >= 120 And dVal < 150 Then
```

```
nRange(5) = nRange(5) + 1
    If dVal >= 150 And dVal < 180 Then
        nRange(6) = nRange(6) + 1
    If dVal >= 180 And dVal < 210 Then
        nRange(7) = nRange(7) + 1
    If dVal >= 210 And dVal < 240 Then
        nRange(8) = nRange(8) + 1
    If dVal >= 240 And dVal < 270 Then
        nRange(9) = nRange(9) + 1
    If dVal >= 270 And dVal < 300 Then
        nRange(10) = nRange(10) + 1
    If dVal >= 300 And dVal < 330 Then
        nRange(11) = nRange(11) + 1
    If dVal >= 330 And dVal < 360 Then
        nRange(12) = nRange(12) + 1
    End If
Next nX
‘establish which element has maximum and
next lesser max
dMax1 = 0: dMax2 = 0
nCounter = 0: nCounter1 = 0
For nX = 1 To 12
    If dMax1 < nRange(nX) Then
        dMax1 = nRange(nX)
        nCounter = nX
    End If
Next nX
For nX = 1 To 12
    If nX <> nCounter And dMax2 <
nRange(nX) Then
        dMax2 = nRange(nX)
        nCounter1 = nX
    End If
Next nX
‘check to see whether there is a 12, 1 or 1,12
boundary
If nCounter - nCounter1 = 11 Or nCounter
- nCounter1 = -11 Then
    nMin = 330: nMid = 360: nMax = 30
    bExtended = True
‘if not then check adjacent boundaries
ElseIf nCounter - nCounter1 = 1 Or
nCounter - nCounter1 = -1 Then
    If nCounter < nCounter1 Then
        nMin = (nCounter - 1) * 30: nMid =
nCounter1 * 30
    Else
        nMin = (nCounter1 - 1) * 30: nMid =
nCounter * 30
    End If
    bExtended = False
```

```
‘otherwise a single boundary
Else
    nMin = (nCounter - 1) * 30: nMid =
nCounter * 30
    bExtended = False
End If
‘ascertain the averaged value
dTotal = 0: nCounter = 0: nCounter1 = 0:
nCount = 0
For nX = 3 To nRows - 1
    dVal = Cells(nX, nWriteCol)
    If Not IsEmpty(dVal) Then
        If bExtended And (dVal >= 0 And dVal
< nMax) Then
            dVal = dVal + 360
            dTotal = dTotal + dVal
            nCounter1 = nCounter1 + 1
            dValArray(nCount) = dVal
            nCount = nCount + 1
        End If
        If dVal >= nMin And dVal < nMid Then
            dTotal = dTotal + dVal
            nCounter = nCounter + 1
            dValArray(nCount) = dVal
            nCount = nCount + 1
        End If
    End If
Next nX
dAverage = dTotal / (nCounter + nCounter1)
Cells(1, nWriteCol).Value = dAverage
Cells(1, nWriteCol + 1).Value = nCounter +
nCounter1
‘obtain the average and count within the range
95% to 105% of dAverage
dTotal = 0: nCounter = 0
For nX = 3 To nCount
    dVal = dValArray(nX)
    If (dVal >= 0.95 * dAverage And dVal < 1.05
* dAverage) Then
        dTotal = dTotal + dVal
        nCounter = nCounter + 1
    End If
Next nX
dAverage = dTotal / nCounter
Cells(2, nWriteCol).Value = dAverage
Cells(2, nWriteCol + 1).Value = nCounter
End Sub
```



Additional charts and graphics begin on page 24.



AMSAT Field Day

by Bruce Paige, KK5DO, kk5do@amsat.org

Once again Field Day has come and gone. There were some areas that were hot and dry, some hot and humid and some where it was just perfect. By the reports that have been sent in, it looks like everyone had a really good time. Looking at the table below you can see that participation is pretty stable. This year there were a fair number of QSO's reported (based on total QSO's divided by two).

	2005	2006	2007	2008
Satellites	8	7	5	8
QSO's	120	258	207	220
Stations	11	21	13	17

The Houston MosQRPitos, using the call W5MSQ, were able to hold on to first place this year with 43 points (down from 53 last year). In second place was the Lafayette



DX Association, W9LDX, with 34 points (down from 37 points last year). Los Chupacabraderrros, N5JO, (satellite station above) dropped from third place last year to sixth place with 20 points (up from 19 last year). This year's third place goes to the Boeing Employees Amateur Radio Society, using the call W0MA, with 23 points.

Fourth place this year goes to W9LJ with



22 points (inched out of third place by only one QSO). Our top home station running on commercial power was W6ASL with 11 points. One station operated with battery power, Patrick Stoddard, WD9EWK, (same as he did last year).

There were 8 satellites used this year with a total of 220 QSO's completed. This year VO-52 carried most of the QSO's with 86, AO-7 phone with 71, and AO-7 CW with 15. On the FM satellites, AO-51 carried 17 QSO's with only 3 stations reporting contacts on both transponders. Only 9 CW QSO's were done on VO-52 this year.

At left and just below is this year's winner, W5MSQ, operating from the Spark's Ranch way out west from Houston.

At the bottom of column 1, Charlie, K5ENG, and Tom, K5SAF, straighten 2 m antenna elements with advice from Michael, W2CVZ, and Laurie, K5LIB.

There was a lot of fun with all the satellites. To amass their high score, they operated all the available satellites in all modes. Andy, W5ACM, says "It became apparent that five watts of transmitter output was often just not enough for SSB contacts through AO-07 and VO-52, so most linear transponder satellite work was done with CW. Our satellite antennas were carefully tested and calibrated prior to Field Day, and it paid off. The coax cables for each band were also tested for loss. The best of the bunch was used for the AO-51 L-band uplink with a reasonably long loop Yagi."

At the Lockheed Martin Recreation Association Radio Club, W5IU, Field Day, the usual dedicated satellite station crew was - Keith Pugh, W5IU; Ray Hoad, WA5QGD and Gary Persons, KD5DAY - did the setup, operating, and teardown. They also had help from Harold Reasoner, K5SXX.

For the Northwest Society of Amateur Radio, W7DU, located in the State of Washington, Carroll Swain said, "The satellite station used the home equipment of W7DU and the following operators N7NHW, KD7YDL, and W7DU. Our two transceivers were rated at 25 watts output on 70 cm and 2 m. We were using a homemade helix antenna on 70 cm and a five element quad antenna

on 2 m."

Here is some real dedication to travelling with all of his radio equipment to get to a field day site. Douglas Papay, KD8CAO, travelled 324 miles from Michigan to get to his dad's (John Papay, K8YSE) Field Day site in Northern Ohio. They were in fifth place this year.

As with all other field day's Murphy is always around and waiting. This year, here is what happened to one site. For the Lake County Amateur Radio Club operating as



W9LJ, pictured above and below. Charlie Sufana, AJ9N, said, "This is our club's first entry into the AMSAT FD competition. As one of the ARISS mentors, I have the equipment. So the LCARC Sat chair sort of fell into my lap. The club had about 20 members help out.

It took us several passes to determine that we had bad coax to the 70cm beam. Once that was fixed, then off we went. Never did hear SO-50 or AO-27 and could barely hear AO-51. So I am not sure what was going on there."

Although they had trouble hearing and operating several satellites, it still put them in fourth place because those satellites were FM and they would have only gained 4 more points. That would have moved them up to third place.



Keith Pugh, W5IU, had this to say about Texas weather, "This year the Lockheed Martin ARC and the Kilocycle Club of Fort Worth shared a common Field Day operation at the Lockheed Martin Recreation Area. Set-up in the summer heat was normal. After the first AO-27 pass on Saturday evening, we lost our shelter due to passage of a strong gust front – winds to 40 mph. We had enough time before the rain hit to put the equipment in a van for shelter. The rain lasted, off and on, for the rest of the night and into the morning."

Next year, I hope that we have even more participants in the AMSAT Field Day. Murphy will undoubtedly show his presence.

73 and Good DX!

Bruce, KK5DO

Here is a table of all entries received. In the case of a tie in the number of contacts, the call signs are listed alphabetically. ☺

1	W5MSQ	43	2A Emerg
2	W9LDX	34	3A Emerg
3	W0MA	23	4A Emerg
4	W9LJ	22	2A Emerg
5	W8DXA	21	2A Emerg
6	N5JO	20	1AB Emerg
7	W8TNO	19	3A Emerg
8	W2MMD	18	8A Emerg
9	W5IU	17	3A Emerg
10	K4HEX	15	2A Emerg
11	VE7RAR	11	2A Emerg
12	W6ASL	11	1D Comm
13	KF4XB	4	1D Comm
14	W6NWG	4	5F Emerg
15	WD9EWK	3	1B Emerg
16	KH6E	2	2A Emerg
17	W7DU	2	4A Emerg

A meeting of the AMSAT senior officers and board of directors was held in Baltimore, MD over the weekend of August 9-10, 2008. This meeting was not an official BOD meeting, but rather an opportunity to address, discuss and brainstorm about many of the challenges facing AMSAT.

The attendees included:

Barry Baines, WD4ASW
Rick Hambly, W2GPS
Gunther Meisse, W8GSM
Tom Clark, K3IO
Lee McLamb, KU4OS
Martha Saragovitz
Lou McFadin, W5DID
Bill Ress, N6GHZ
Andrew Glasbrenner, KO4MA
Gould Smith, WA4SXM
Frank Bauer, KA3HDO

The meeting began with an exercise to identify strengths and weaknesses, as viewed by each attendee, across several areas including Management, Strengths, Money, Outside Environment, Mission, Technology and Structure. The comments were often in sync across the attendees. Most identified communications both within the leadership and between the leadership and the membership as problematic and various improvement strategies were suggested and discussed. Many comments and extended discussions occurred on how the satellite construction and launch environment has changed significantly since the last high orbit project was initiated and strategies that AMSAT will need to employ to overcome these new hurdles.

Several attendees suggested that the organization might be attempting too many projects at once resulting in a strain on resources, both in terms of manpower and finances. One technique that was generally agreed upon was the fabrication of multiple modules that can be used as "building blocks" for short fuse launch opportunities that may arise. There was a division over what sort of missions should be considered as priority. Should AMSAT concentrate on state of the art packages such as the ACP, or concentrate on supporting existing users with legacy modes and bands before moving to more complex systems?

Most, if not all, attendees agreed that the mission statement should be revised at the October BOD meeting. The revised statement should address the inclusion of fixed dates as well as redefine the orbits considered as acceptable for any future mission such as Eagle or Rideshare.

In-depth discussions were also held regarding the recent problems in the Engineering leadership, including a presentation of a new engineering department plan by a committee appointed by the President prior to the meeting. The new plan includes renewed efforts in the direction of project and volunteer management. Additional leadership discussions focused on the need to involve more and new volunteers and a renewed effort to recruit and involve future replacements for existing officers and key players. There are currently several key leadership positions in need of a volunteer.

Brief summary reports were presented by the various departments represented including the Treasurer, Operations, User Services, ARISS/Manned Spaceflight and the Executive VP.

The attendees also developed a list of "To Do" items for the organization, and then sorted them by priority and difficulty. The most important and the easiest to accomplish were both assigned to volunteers or department leadership, with the priority list marked for completion by the end of the year, or earlier in some cases. The 2008 priority list and responsible parties are listed below. If you can assist with any of these, please contact the listed volunteer!

2008 Priorities

Rideshare RFI

- Lee McLamb

Fill Vacant Executive Team positions

- Barry Baines, Tom Clark, Bill Tynan and Andrew Glasbrenner

Deliver IHU to AMSAT-DL

- Rick Hambly and others

AIMS Implementation

- Rick Hambly and Gunther Meisse

New Webmaster

- Rick Hambly

DHS and other creative funding

- Tom Clark and a grant writer

AMSAT PR Committee for Atlanta

- Barry Baines, Gould Smith and Martha Saragovitz

Web site Satellite Status Updates

- Andrew Glasbrenner

The meeting concluded late Sunday afternoon with a renewed sense of dedication to the organization and several new strategies and ideas to develop to allow us to meet the organization goals and member expectations.



Release for AMSAT on June 15, 2008: CFC Certification 2008

On June 13, 2008 the The Office of Combined Federal Campaign Operations issued the final draft of the listings for independent organizations that have been approved for participation in the 2008 CFC. The Radio Amateur Satellite Corporation (AMSAT) was again included in the approvals.

The CFC, or Combined Federal Campaign, is the U.S. Government equivalent of the United Way in the private sector. The campaign affords all US Government employees the opportunity to make donations from their regular paychecks to CFC approved charities. AMSAT has again successfully applied to CFC for that status and is grateful for the approval. This stamp of approval means that AMSAT has met the strict standards set by the U.S. Office of Personnel Management (OPM) assuring donors that our programs of work and financial operational standards meet the standards for expectable operations and programs.

Those AMSAT supporters who wish to make payroll contributions should select the Radio Amateur Satellite Corporation (AMSAT) during their campaign this coming fall. The AMSAT CFC Charity number is 10158. Payroll deduction is a simple, convenient way to support your AMSAT.

Gunther Meisse, W8GSM
Treasurer
AMSAT North America



ATTENTION FEDERAL EMPLOYEES

AMSAT is now a member of your CFC
(Combined Federal Campaign).
When you complete your pledge for this
year's campaign, why not make a
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Satellite Corporation.

The agency number is: CFC 10158

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AMSAT is the North American distributor of **SatPC32**,
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Version 12.8 has improved Windows Vista compatibility and enhanced support for tuning multiple radios.

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Kenwood TS-790 and TS-2000
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- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.
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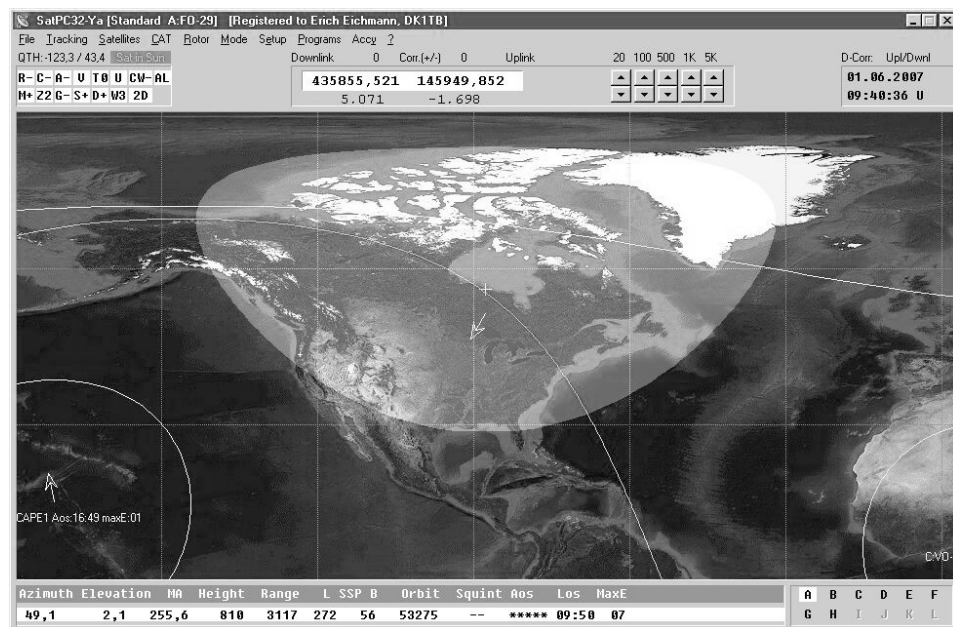
Price is \$45 for AMSAT members, \$50 for non-members, on CD-ROM.

A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>

A registration password for the demo version is \$40 (members), \$45 (non-members).

Order by calling 1-888-322-6728.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.





LVB Tracker Box

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- Built-in rotor interface cable with DIN connector
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Contact Martha at the AMSAT office 301-589-6062 to order.

The complete units will be built in groups, so get your orders in early.

Units will be shipped as they become available.

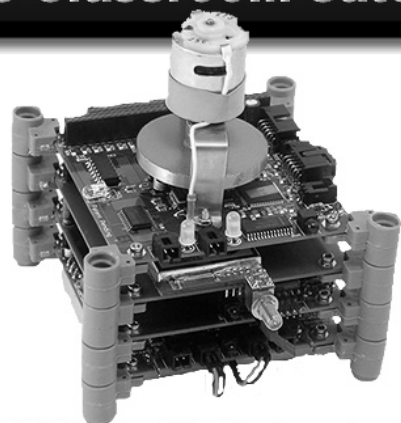
- 1) Bare board - \$20 + S&H - no parts kits available
- 2) Populated board, serial interface - \$100 + S&H - no kit with USB unit, rotor cable and LCD available, we do have a parts list with recommended part numbers and sources.
- 3) Custom Ten-Tec Enclosure powder coat, silk-screened, drilled/punched - \$50 + S&H
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Boards and complete units may be ordered from the AMSAT office at 301-589-6062 or from martha@amsat.org



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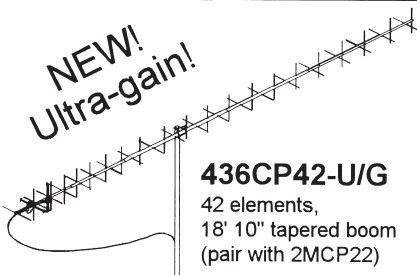
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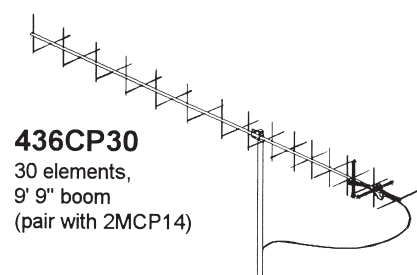
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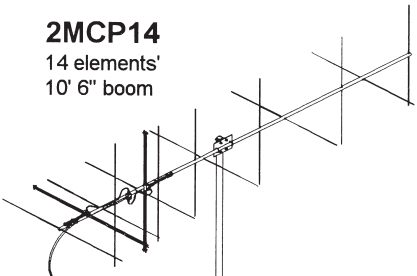
NEW! Ultra-gain!



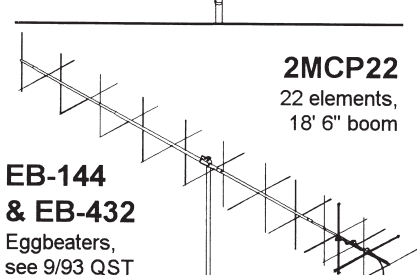
436CP42-U/G
42 elements,
18' 10" tapered boom
(pair with 2MCP22)



436CP30
30 elements,
9' 9" boom
(pair with 2MCP14)

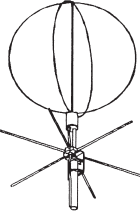


2MCP14
14 elements'
10' 6" boom



2MCP22
22 elements,
18' 6" boom

EB-144 & EB-432
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Simultaneous Use of Receive and Transmit Converters with 2 M IFs

Alan P. Biddle, WA4SCA, wa4sca@amsat.org

The frequencies we use for satellite operations are slowly migrating upward from the traditional 2 m and 70 cm bands, though these still represent the majority of current operations. Since most converters have 2 m IFs, this often limits operations to a mode using 70 cm for either receive or transmit, and another band such as the 13 cm or 23 cm for the matching band. This has a dramatic effect on the number of users. One can see this by comparing AO-51 modes. Mode VU is of course the most heavily populated. Mode LU voice and data, has a modest turnout, as does the slightly more popular VS mode. Mode LS by comparison has normally no more than 5 users in North America. It is the norm to spend an entire pass with no other stations heard.

Admittedly more equipment is needed, but the disparity seems excessive. In talking with other stations, I find there are two issues that discourage operating on higher frequencies. First, there is a reluctance to use the same IF for uplink and downlink, on the assumption that there will be overload or intermod. Second, for full duplex operation, you need a second 2 m capability, though there are a few converters which have a 70 cm IF. So how do you solve this problem? You cheat!

The actual configuration is simple, though there are some factors to consider in making it all work. My station uses the FT-847, and the technique I use should work with the TS-2000, and probably some stations which use multiple rigs. For Mode S downlink, I have a low noise preamplifier mounted at the dish

antenna, and a converter from 2.4 GHz to 2 m in the shack, for improved temperature stability. The next step is a 2 m to 10 m receive converter, found at a hamfest. The FT-847 is effectively a 2 m rig, a 70 cm rig, and a third high frequency (HF) rig for 6 m and down in the same box. In full duplex mode, you can use any two sections, so I can use the HF section to receive and free the 2 m section for transmit duties. Adding the two converter local oscillators gives a single LO which any of the popular tracking software such as SATPC32 or MacDoppler can use to calculate the correct Doppler corrected frequencies. Existing antenna switches allow me to add receive and transmit converters as needed.

The real question is how do you keep from QRMing yourself when the 2 m transmit signal, either direct to the antenna, or through an uplink converter, overlaps the 2 m receive IF? The answer is partially construction technique, and partly planning component LOs. At the top of the list is to use quality cable anywhere in either 2 m section. In the case of having the downlink to 2M converter in the shack, you can actually connect it directly to the 2 m to 10 m converter using a barrel connector. However, this is not really necessary. A good quality cable is fine, and makes it much easier to switch different units. Power leads may also need bypassing or the addition of chokes.

The real issue is to keep adequate frequency separation between the IFs. Ideally, they should be separated by a few hundred

kilohertz. Consider first Mode VS. Transmission occurs on 145.880 MHz. The Mode S downlink is 2401.200 MHz, which converts to 145.200 MHz from the converter, and then finally to 29.200 MHz at the rig. Separation in the 2 m sections is 680 kHz, and there is absolutely no detectable interference at any power level. In fact, tests have shown that at the 50 watt transmit level, I can be within 30 kHz of the 2 m receive frequency before anything is detected. Note that this will very dependent on how well your shack is cabled, and will certainly be more sensitive if the Mode S to 2 m converter is mounted directly at the antenna feed, due to the long run of parallel cables.

From a power standpoint, using a transmit converter is a much easier situation since the 2 m drive power will seldom exceed a watt, and often much less. What about frequency separation in Mode LS? For instance, my Mode L converter uses an 1124.000 MHz LO, which yields a rig frequency of 144.700 MHz to reach the 1268.700 MHz uplink frequency. This is a 500 kHz separation of the IFs, which is ample. Since most transmit converters allow for a switchable alternate LO, a second crystal can usually be added if necessary to increase the IF separations.

This technique works well on AO-51, and will be usable on future satellites with a bit of careful frequency analysis and good construction techniques. It is certainly worth the effort, as both Modes VS and LS yield superior audio, even above the excellent VU results. 🌐



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Museum Ships Weekend Provides Opportunity to Showcase OSCAR Satellites

by Allen F. Mattis, N5AFV, n5afv@amsat.org

When the Brazos Valley Amateur Radio Club (BVARC) decided to participate in the annual Museum Ships Weekend Event sponsored by the Battleship New Jersey Amateur Radio Station on June 7-8, 2008 a wonderful opportunity was provided to demonstrate the OSCAR satellites and Amateur Radio. During the weekend event Amateur Radio operators activated radio stations on 76 museum ships worldwide. Most of the museum ships were located in the United States; however, museum ships in Australia, Austria, Belgium, England, France, Germany, Italy, Netherlands, Spain and Sweden also participated. Amateur Radio operators who contacted any fifteen of these ships qualified for a handsome certificate. During the event the Brazos Valley Amateur Radio Club (BVARC) was allowed to activate club station KK5W from the museum ships located on Pelican Island in Galveston, Texas.

Seawolf Park on Pelican Island contains a number of USN ships that are no longer afloat but are viable and active museum ships. The destroyer escort USS Stewart (DE-238) is the largest of these ships. The submarine USS Cavalla (SS-244), nicknamed the "Lucky Lady" by submariners, is located approximately one hundred feet to the portside of the Stewart. During the Battle of the Philippine Sea on June 19, 1944 the Cavalla torpedoed and sunk the Japanese carrier Shōkaku that had participated in the attack on Pearl Harbor. Because the USS Stewart and the USS Cavalla are located side by side, a contact with KK5W counted as working two ships. Part of a third ship is also displayed in Seawolf Park. The conning

tower or sail of the submarine USS Tautog (SSN-639) comprises a nearby exhibit that was dedicated to all Cold War submariners on Memorial Day 2006 by P G Klintworth and C A McNeil, Jr, former commanding officers of the Tautog.

The principal operating location for the BVARC Amateur Radio operators was the radio room of the USS Stewart. The radio room contains a considerable amount of vintage radio gear that is no longer operational but serves as a museum display. The Amateur Radio operators brought along their own equipment but did use the Stewart's longwire antenna that has been restored. The radio room operation was supplemented by the use of portable radio equipment out on the deck from both the stern of the USS Stewart and from the bow of the USS Cavalla. It was this equipment out on the deck that was used to work passes of AO-27 and SO-50.

The club made over two hundred radio contacts from the Stewart's radio room during the weekend. Contacts were made with Amateur Radio stations on the USS Lexington (CV-16), the USS Missouri (BB-63) and the USS Texas (BB-35). A few of the participating ships had restored vintage radio equipment that used the AM mode, but the USS Stewart operation used modern SSB equipment. In keeping with the spirit of the event, however, a number of Morse code contacts were made from the Stewart's radio room.

Out on the deck, an Icom W32A HT with an Arrow antenna mounted on a tripod were used to work two passes each of AO-27 and SO-50. A total of 29 satellite contacts were



Figure 2: Allen Mattis, N5AFV, (left) and Darrell Kirk, KC5JAR, (right) found that a strong wind made it difficult to work SO-50 from the bow of the USS Cavalla. (Photograph by Norma Stone, KE5NDN.)

made with stations in fourteen US states and two Mexican states. The Arrow antenna on the tripod drew a lot attention from visitors to the ship. The night before, a Boy Scout troop had an "overnight" on board the USS Cavalla and a number of the scouts watched one of the satellite passes and asked many questions. Hopefully their interest was piqued enough that they may pursue the Radio merit badge. Most of the scouts who watched us work the pass thought it was exciting to talk to someone through a satellite using Amateur Radio.

It was very enjoyable and rewarding to participate with the Brazos Valley Amateur Radio Club (BVARC) in the annual Museum Ships Weekend Event. ☺



Figure 1: Seawolf Park is home to the destroyer escort USS Stewart and the submarine USS Cavalla. (Photograph provided by Claude Sessions, K5HFY.)



Figure 3: The stern of the USS Stewart provided shelter from the wind for working an AO-27 pass. (Photograph by Bill Stone, WS5H.)

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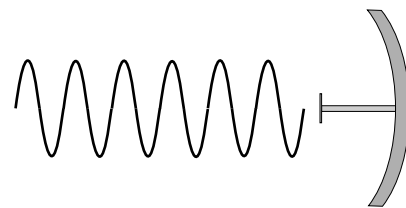
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AO-16 Returns to Operation Again

by Drew Glasbrenner, KO4MA,
ko4ma@amsat.org

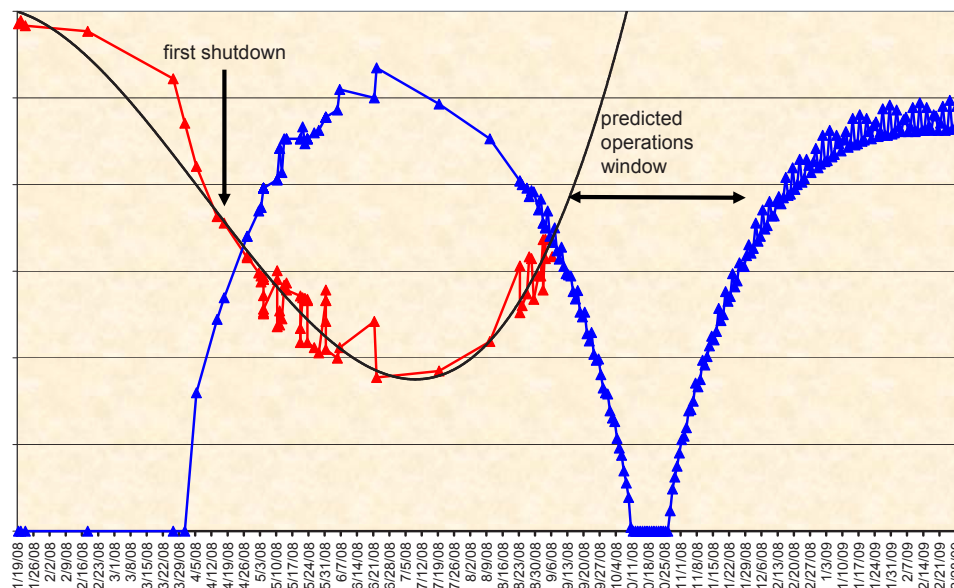
Last April AO-16 began experiencing random resets cutting short the satellite's recent retasking as a voice repeater. This failure mode was common to the original microsats, and is theorized to be the result of degradation of a transistor in a watchdog circuit. The time constant of this transistor failure is very temperature dependent. AO-16 was in a state of constant illumination during the time it was recovered and retasked to voice operation, so temperatures remained high and the watchdog did not fire.

After the spacecraft began resetting in April, AO-16 Command Station Mark Hammond, N8MH, continued to collect temperature telemetry by manually turning the spacecraft on and quickly collecting MBL data before it reset. By combining that telemetry with eclipse length data, and when the resets began, Mark was able to predict with a fair degree of accuracy when the spacecraft would again be able to sustain operations. The attached graph displays the result of his work.



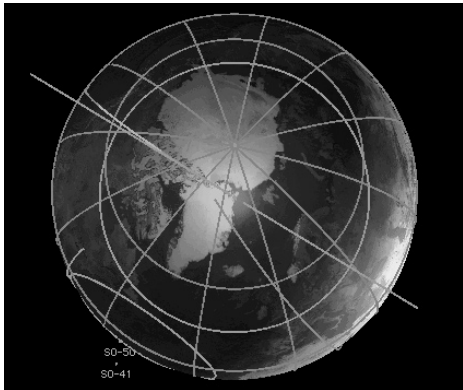
A base temperature of approximately 19 degrees is warm enough to keep the satellite running without intervention, and this period is expected to exist from roughly mid-September to late November. This temperature corresponds to roughly 85 percent illumination.

After the current full illumination cycle, AO-16 will experience longer and longer eclipses, likely precluding any further sustained operation for quite a while. Please enjoy the satellite while you can. Remember the uplink is the same as AO-51, 145.920 FM, and the downlink is 437.026 DSB. Most find USB best to use for the downlink.



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iRotorDDE: A DDE Interface for the AA2TX iRotor

by Bruce Robertson, VE9QRP, ve9qrp@gmail.com

As I've built and improved my LEO satellite station over the past three years, I've made incremental improvements through reliable home brew projects. Home brew is fun as long as you don't get in too deep over your head, so I tried to concentrate on things I knew I could build myself without too many electrical or mechanical complications. In LEO satellite operations, this probably means the antenna system. So after buying a second-hand VHF/UHF SWR meter, I constructed a pair of Yagis using the 'Cheap Yagis' design of Kent Britain, WA5VJB. When you Google for this design, be sure to find the version that includes 435 MHz models, such as <http://portal.ucpel.tche.br/py3vhq/home/antennas/uhf-sw.pdf>

They worked fine. I used these handheld for a while, and then copied them for use in an outdoor rotating antenna assembly that included on-mast low-noise preamps.

With an 8-element UHF antenna and a 4 element VHF, there was no need for an elevation rotor. As many have reported on AMSAT-BB, a fixed elevation of, say, 20 degrees above the horizon will provide an elevation antenna pattern that is filled fairly nicely from somewhere slightly above the horizon to about 60 degrees as long as the antennas are of a modest gain. An azimuth rotor was easy to come by in a second-hand Gemini Orbit360 model. Though no longer manufactured, these can be found for a reasonable price in online auctions, and despite their low price, are controlled by a feedback loop using a potentiometer mounted at the rotor motor. I liked my first one so much that when another became available at the right price I snapped it up, too.

Time passed, the QSOs piled up, and - perhaps inevitably - I began to dream of greater things for my satellite station. Automatic rotor control would be fun to have for late-night telemetry collection; and longer Yagis might help me work satellites closer to the horizon. (From my QTH, a contact to Asian Turkey via AO-7 is a theoretical possibility. Imagine the bragging rights!) But longer Yagis would mean a narrower vertical beamwidth. To correct for this, I would need azimuth *and* elevation control. That seemed like a good next step to take anyway, because

future HEO operations would require a high-gain antenna, and that would necessitate full az-el control. But how to get there? Sure, I could trade in my Orbit360s for a full-price commercial az-el rotor system, but saving up for one of those *and* for the computer rotor interface would take a long time and somehow would diminish the do-it-yourself vibe I'd tried to maintain.

The solution was found in pages 10-12 of the January/February 2006 issue of *The AMSAT Journal*. In an article entitled "Control Your Antennas with A Digital Pot", Tony, AA2TX, hacked the rotor controller of the Orbit360 with a cheap digital potentiometer integrated circuit. He wrote some software that made a PC talk to those chips using a parallel port, and voilà! computer control of my rotors for under \$25! It was so easy to do that I started with azimuth control only, using the rotor and short Yagis I had in place on the mast. Now, what Tony had done was pretty new. Unlike traditional track boxes, the output of *his* software was not ASCII, but rather digital commands using a chip-to-chip protocol called SPI (short for 'Serial Peripheral Interface'). These commands told the digitally controlled potentiometer what value it was to be set. This potentiometer was inserted in the controller circuit to replace the one originally connected to the dial on the rotor controller. No satellite software packages spoke this language, so Tony wrote a simple DOS command line program and a driver for Instant track, a venerable and full-featured DOS tracking program with which he was very familiar.

You would think I'd be pretty happy about all this, especially since Tony was so kind as to modify the software to suit azimuth-only operations like mine. But soon I yearned for yet another incremental improvement, this time relating to the satellite prediction and radio-control software. Although Instant-Track is an excellent package, I had become used to playing around with a variety of these tools. For instance, when I had visitors to the shack, I found that Nova's view from space helped people understand the physics of orbits more intuitively than 2D displays. (SatPC32 now offers a similar 3D display.) I like using Ham Radio Deluxe because I appreciate all the work Simon has put into this package, and it has some very nice

orbit prediction graphs. Finally, like many others these days, I love the many features of SatPC32, which AMSAT members can buy at a special price along with their annual membership. Because of the unique nature of AA2TX's rotor control hardware, none of these other programs could control my rotors, and I had found that I sometimes had difficulties configuring Instant track to control my radio through a USB-to-serial converter. (This is probably my fault: I speak better Etruscan than I do DOS!)

Fortunately, AA2TX included in his software package the DOS command line program I mentioned above. If this could be evoked from data given by Nova, HRD and SatPC32, then the iRotor hack would even work with these packages. All of these programs have the ability to publish basic information about the current satellite and its azimuth and elevation using Windows' DDE ('Dynamic Data Exchange') information exchange system. Using DDE, programs can send and receive information between each other. A client program can request and read the information from a server program. The satellite tracking programs publish information on unique channels, which are specified with text addresses. DDE has been a useful tool for other integrated satellite-related programs, like WispDDE.

So what I needed was a program that would periodically read the satellite position information published over DDE by the satellite tracking software and, when necessary, use it to evoke AA2TX's DOS command line program. While it would be possible to write 'glue' code like this in a compiled computer language, it is usually easier to use one of the scripting languages. I had some experience with Perl, Python and some others; which one would be right for this job?

To my mind, the trickiest part was the routine that read data from the DDE channel. There was no way I was going to be able to write that myself and debugging some half-baked implementation would take all the fun out of the project. So I searched for a scripting language that had DDE support that was simple and robust (by which I mean, "even I could get it to work"). One clear winner emerged: Tcl. Tcl, the 'tool control language', is the granddaddy of scripting languages at



just about 20 years old. Its author, John Ousterhout, who worked on this while he was a professor at U.C. Berkeley, probably invented the term 'glue language'. Today, Tcl is perhaps better known as the language that spawned 'Tk', a early GUI programming toolkit. A team of contributors developed Tcl and Tk, and they publish their source code under a Open Source license. I had bought a small book on Tcl about a decade ago; this was dusted off and the fun began. A script soon emerged that provided simple and effective control. Called iRotorDDE, the current version of this is published on the Google Code website at <http://code.google.com/p/irotordde/>.

iRotorDDE's script works as follows:

1. It checks to see if there is a running version of the AA2TX iRotor driver, called 'ROTORDRV.EXE'. If there is, it does not start another because this can cause unpredictable results. If there is not, it starts the driver using the parameters set in the variables at the beginning of the iRotorDDE.tcl script.
2. It looks for DDE data from the channels set up by SatPC32 and Nova/HRD, in that order. If it finds data, it prints out a line notifying the user of this and then, for the remainder of the session reads from that DDE channel. (For this reason, it is not possible to switch satellite tracking programs during a single session of iRotorDDE.) If it does not find data, it assumes you have yet to launch your satellite tracking program and returns to step 1, looping until DDE data is found.
3. It reads DDE data and parses the string to extract the satellite name and azimuth and elevation values. If no DDE data is found, it continues to step 7.
4. It prints the name of the satellite being tracked.
5. It evokes the 'ROTOR.EXE' command to set the position of the rotor to the values of the azimuth and elevation read from the DDE data.
6. It waits an assigned period of delay, then returns to step 3.
7. At this step, it is assumed that the satellite tracking program discovered in step 2 has been shut down. iRotorDDE exits and no longer tracks satellites.

To use iRotorDDE on your tracking computer, following these steps:

1. Ensure that your iRotor system is working well without iRotorDDE. Familiarize yourself with AA2TX's 'ROTORDRV.EXE' and 'ROTOR.EXE' commands to direct your array where you wish.
2. Download and install an interpreter for the Tcl script language if you do not have one. I used ActiveState's activeTcl version 8.4.13, which was free of charge. ActiveState do not make it very easy for you to install this free and open source project, but if you persist you'll download the basic version from <http://www.activestate.com/store/activetcl/> I found a direct link at <http://downloads.activestate.com/ActiveTcl/Windows/8.5.0/ActiveTcl8.5.0.0.283511-win32-ix86-threaded.exe> Although this is a computer language, you install it as you would any other program.
3. Download and install the iRotorDDE.zip file from Google Code. Put the two iRotorDDE files in the directory where AA2TX's programs are found. Next, you need to configure the iRotorDDE script to suit your environment and uses. This is done by changing values of variables at the top of the iRotorDDE.tcl file using a text editor like notepad. These inform the script as to where the iRotor binary files are found on the computer, and how you want the rotor to operate. Many of these parameters correspond to ones in the command-line version of AA2TX's code, and you will find additional information about them in his notes.
4. Once iRotorDDE.tcl is configured and saved, start it by double-clicking on the .bat file (the one with the little gear in its icon). This should bring up a windows terminal with scrolling text to inform you about the status of iRotorDDE. It will launch the RotoroDRV TSR program according to the parameters you set in the previous step and then either connects to a DDE server if it finds one or waits until one appears.
5. Start a DDE server in your satellite tracking program. SatPC32 starts with the DDE server already running. HRD does not. Do not attempt to start it with the 'DDE Monitor' menu item in the main 'Tools' menu. Instead, start satellite operations with the 'Satellites' button. Then select the 'DDE' tab

in the satellite window and click on the 'Start' button to begin the DDE server. Currently, HRD only serves satellite DDE data in the Nova format. If this changes in the future, be sure to select either Nova or (if it is available) SatPC32.

As you can see from the picture above, iRotorDDE is a rather verbose: it provides the raw data that it is parsing, as well as the derived azimuth and elevation. When you switch satellites in your tracking program, iRotorDDE will switch too and print out the name of the new bird, but there is a user-configurable delay so you can take a quick sneak peek at a different bird without commanding the rotor to swing all the way around. It will also tell you what azimuth and elevation iRotor reports it is using. If iRotor is using its antenna-flipping algorithm, these differ, but the array is still pointing correctly. Also, if the currently tracked satellite is below the horizon, the DDE information will contain a negative elevation values. iRotorDDE blindly passes these directly to the AA2TX command line program, but the command line program is smart enough to start and stop tracking at -5 degrees elevation. To quit iRotorDDE, just quit your server satellite tracking program; to quit it prematurely, use the Control-C command or close its terminal window. Note that SatPC32's Rotor-On/Off toggle will not change the behavior of iRotorDDE because this program works outside SatPC32's rotor control routines.

That's all there is, really. I've been using iRotorDDE for over a year now in one version or another, and I've been quite happy with it. Very rarely its string parsing routines get hung up on a satellite's name, perhaps due to a space appearing in it. Because Tcl is easy to understand, I hope others will feel free to improve and make use of this program as they wish. I posted the code on the Google code site so that if anyone wishes to make improvements can do so with my permission. For new or prospective satellite operators, I hope this is an encouragement that the upgrade path to HEO does not need to entail massive outlays on commercial rotor systems; if you enjoy tinkering and homebrew, there are many ways to make an effective satellite station for much less than full price.

Am I now ready to call my rotor system complete? Not quite. When I look at all the features SatPC32 (for instance) provides to



rotor controllers like FodTrack or the popular LVB tracker, I'm a bit jealous: automatic parking, gain-based rotor movement, and trim adjustment would be pretty nice to add to my station. With a couple more software tricks, we can get our iRotor array to be driven directly by SatPC32, but that, as they say, will have to wait for another article.



```
D:\WINDOWS\system32\cmd.exe
D:\Documents and Settings\Bruce\My Documents\iRotorDDE_SUN>telsh iRotorDDE.tcl
test result: RotorDRU is not loaded

Tracking Status: ENABLED
*****Welcome to iRotorDDE*****
Testing for live DDE Server
info: SNL0-19 AZ258.6 EL-0.8 UP370 UMCW DN437129249 DMCW MA76.8 <> <>
az: 258.6; el: -0.8
SatPC32 is live. It will be used as the server
info: SNL0-19 AZ259.0 EL-0.8 UP370 UMCW DN437129200 DMCW MA76.9 <> <>
az: 259.0; el: -0.8
+++++++ Setting rotor to Az: 259 El: -1

Rotor Position <Az,El>: 79, 181
info: SNL0-19 AZ259.6 EL-0.7 UP370 UMCW DN437129118 DMCW MA77.2 <> <>
az: 259.6; el: -0.7
+++++++ Setting rotor to Az: 260 El: -1

Rotor Position <Az,El>: 80, 181
```

Command line results obtained when loading iRotorDDE.tcl

Volunteer for AMSAT

Help Wanted AMSAT needs qualified volunteers for a number of positions!

If you want to be a part of the solution in making AMSAT operational and work toward designing, building and finding a launch, WE NEED YOU!

No pay for 5+ hours per week, but a great deal of satisfaction in knowing you are helping make something happen.

We need people with these skills:

- Marketing
- Sales
- Software engineering
- Hardware engineering
- PC based software design
- Web design and maintenance
- Project management
- Documentation
- Hardware testing
- Software testing
- Hardware prototyping
- Specific area Web site information maintenance
- Video recording, digital conversion and editing
- Write technical or instructional material
- Educational activities
- Promoting AMSAT as an Area Coordinator



and any other area you think you think you can make a difference.

We often have people volunteer, but many don't deliver on their promises. So, pick an area that you think needs improvement and explain what you will do to make it better. Then do something to show that you can follow through.

Send your suggestions, actions plans and a description of why you are capable of doing this task to Gould Smith, WA4SXM, wa4sxm@amsat.org

The AMSAT Store should be back online soon! Here are some more AMSAT products.

AMSAT 10' locking carpenter's tape \$5



AMSAT offers a 2GB Flash Drive with the AMSAT logo and a neck lanyard. Save your stuff and show your support for AMSAT. \$20 + Shipping (limited supply)



Figure 7: +X axis magnetometer flux data collated from general database plus averaged +X data. Database includes frames telemetered at 5, 2 minute and 30 seconds intervals.

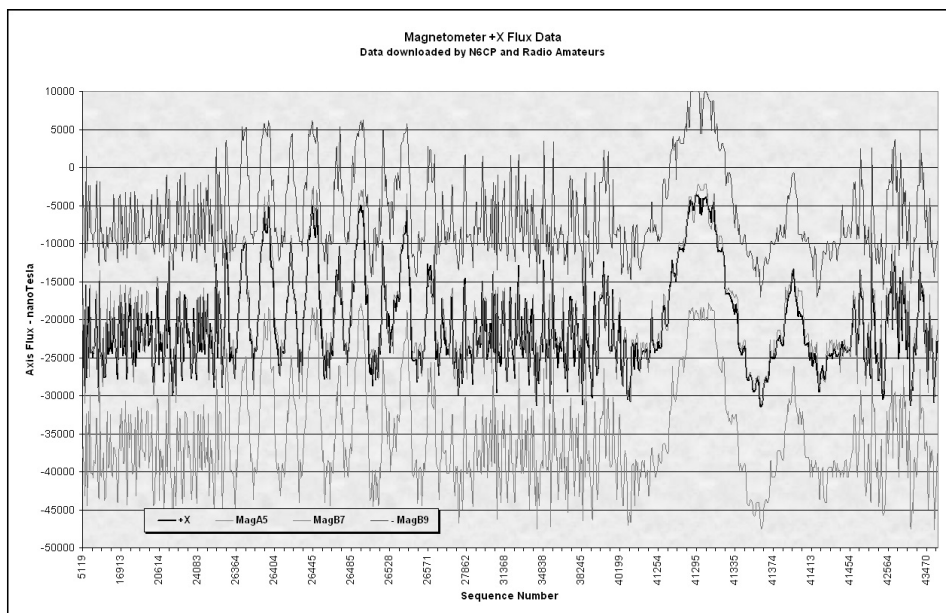


Figure 8: +Y axis magnetometer flux data collated from general database plus averaged +Y data. Database includes frames telemetered at 5, 2 minute and 30 seconds intervals.

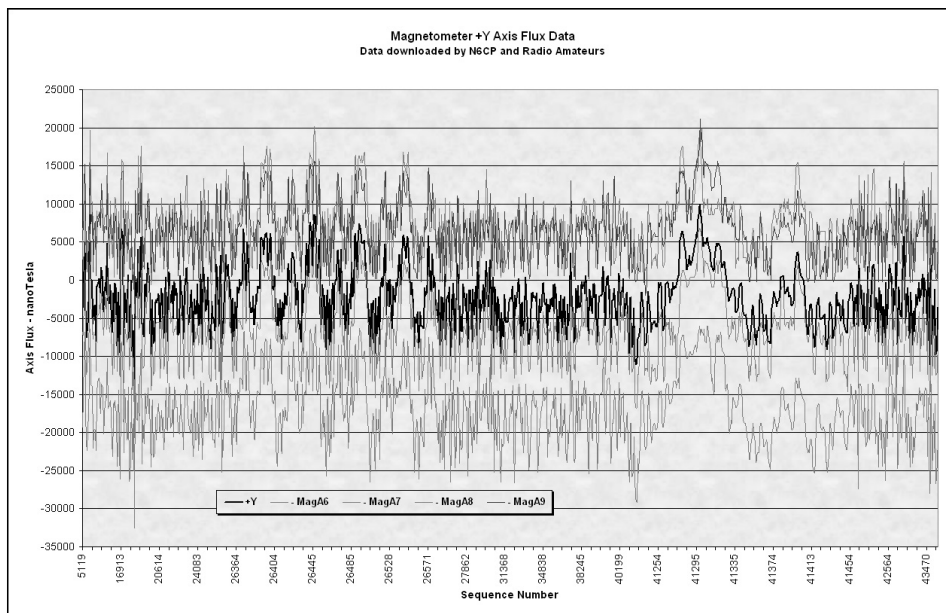


Figure 9: +Z axis magnetometer flux data collated from general database plus averaged +Z data. Database includes frames telemetered at 5, 2 minute and 30 seconds intervals.

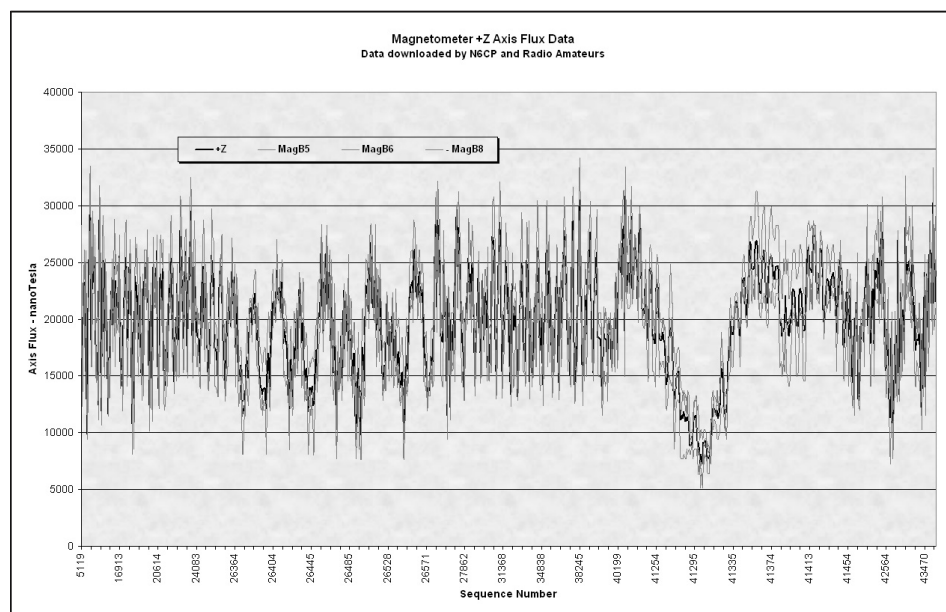


Figure 10: Speed distribution profiles for 24th May, 12th June and 21st June 2007.

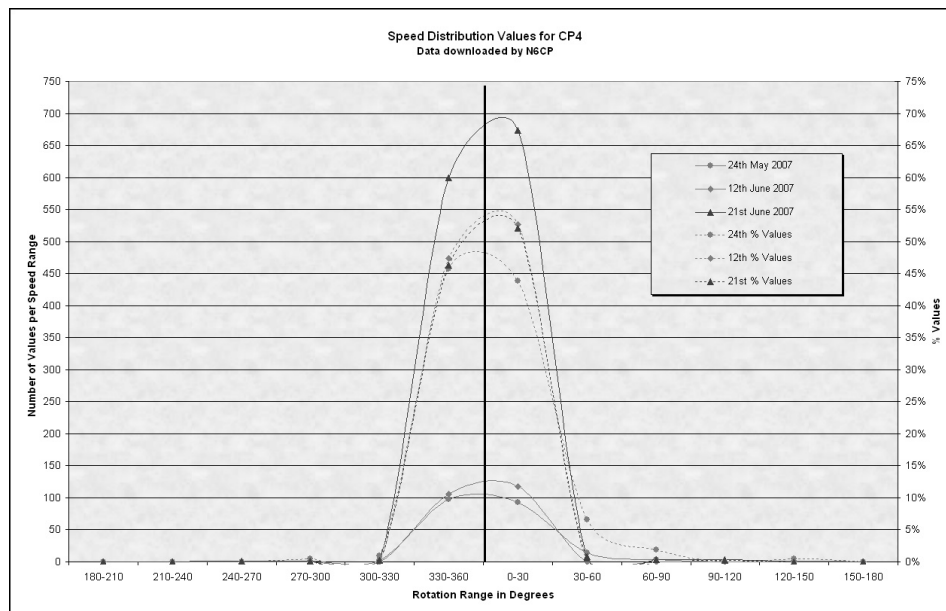


Figure 11: Magnetometer layout and world magnetic map axes.

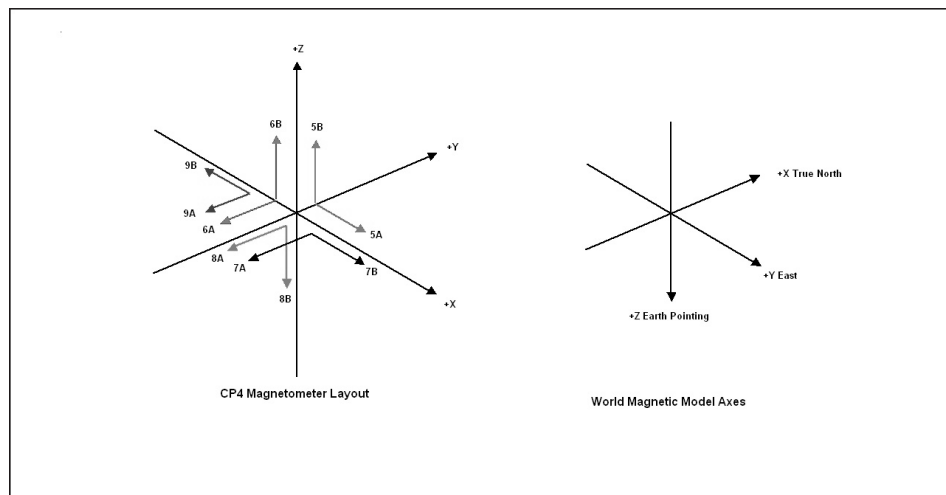
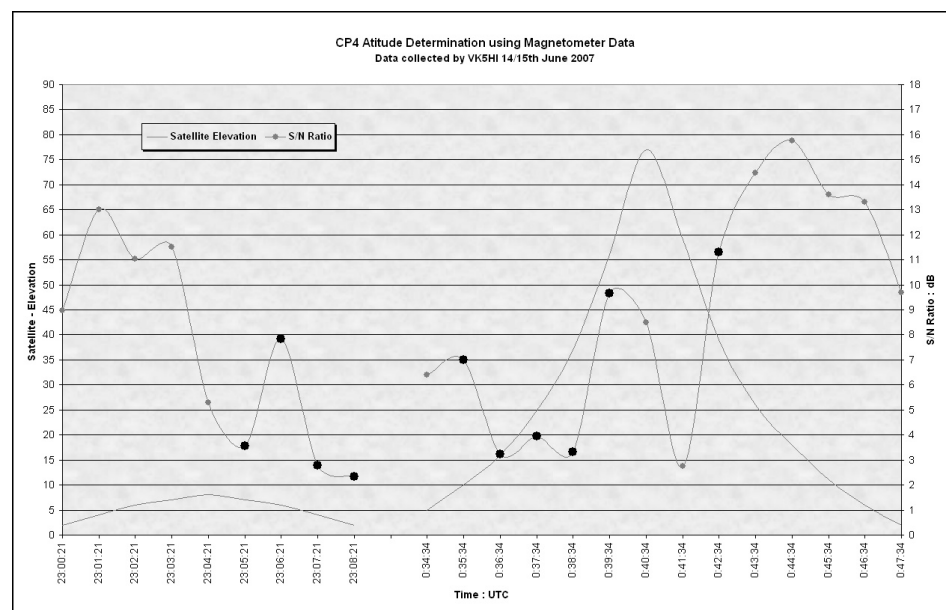


Figure 13: Appendix C : Confirmation of attitude by observation.



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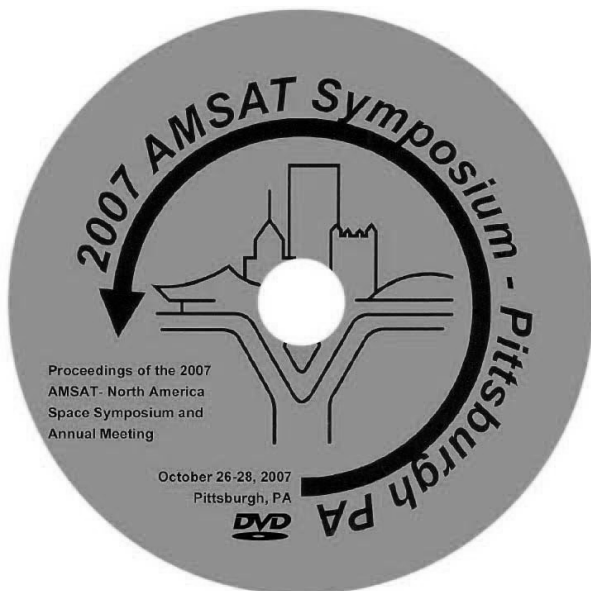
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Minutes of the AMSAT Board of Directors Meeting

October 25-26, 2007

The Radio Amateur Satellite Corporation (AMSAT) board of directors meeting started at 0812 EST on Thursday, 25 Oct 07 at the Airport Marriott Hotel, Corapolis, PA.

All seven BOD members were present:

Barry Baines, WD4ASW
Tom Clark, K3IO
Drew Glasbrenner, KO4MA
Rick Hambly, W2GPS
Lou McFadin, W5DID
Bob McGwier, N4HY
Gunther Meisse, W8GSM
Lee McLamb, KU4OS (Alternate)

Guests present at the start of the board meeting:

Dan Briner, AB3EN, VP-Marketing
Larry Brown, W7LB
Robin Haighton, VE3FRH, Immediate Past President
Jim Heck, G3WGM, AMSAT-UK Honorary Secretary
Bill Hulse, W5NI
Hartmut Pasler, DLIYDD, AMSAT-DL VP and BOD member
Dee Interdonato, NB2F
Keith Pugh, W5IU, Director-Net Operations
Nick Pugh, K5QXJ
Martha Saragovitz, Manager
Jim Sanford, WB4GCS, Eagle Project Manager
Gould Smith, WA4SXM, VP-User Services
Mike Young, WB8CXO

Proposed Slate of Officers/ Organizational Structure

AMSAT President Rick Hambly, W2GPS, announced a proposed revamping of the Marketing and User Services area. The VP-Marketing and User Services position has been open for over a year. Rick proposed that the position be split into two areas with both positions reporting to the president. One position will be designated VP-Marketing and the other VP-User Services.

VP-User Services will have responsibility for:

- Contests and Awards
- AMSAT News Service (ANS)
- The AMSAT Journal
- AMSAT Nets
- Field Operations

VP-Marketing will have responsibility for:

- Strategic Marketing: Image and Message
- Sales
- Web Site and Internet Store
- Electronic Communications (Mail Alias service and Mailing List services)

Frank Bauer, KA3HDO is designated as Director-Human Spaceflight.

Background: In 2004, the Board expanded the number of senior officer positions by adding the positions VP-Marketing & User Services and VP-Human Spaceflight. With the proposed split of responsibility of Marketing and User Services AMSAT President Rick Hambly, W2GPS, proposed that VP-Marketing, VP-User Services

and VP-Spaceflight no longer be considered as senior officers which previously required BoD approval of the nominee. Instead, these would be positions created and appointed by the AMSAT president.

A motion was then made to have only BoD members vote on senior officers as defined by the AMSAT Bylaws:

VP-Operations
Executive Vice President
VP-Engineering
Manager
Secretary
Treasurer

After discussion, by a vote of 6-1, the BOD approved the motion (Baines opposed).

The next question discussed covered a basic issue: "Do the senior officers report to the BoD or to the AMSAT president?" Background: This issue was raised because of past instances where certain senior officers took the position that since the BOD approved their appointment; they were not obligated to adhere to the implementation of various policies under the leadership of the AMSAT President.

Bob McGwier, N4HY, made a motion that "The AMSAT Board of Directors assign a duty to the corporate officers that they coordinate their activities with and through the President." Gunther Meisse, W8GSM, seconded the motion. After further discussion, the motion passed by a vote of 7-0.

Slate of Officers Offered by President Rick Hambly, W2GPS:

President: Richard Hambly, W2GPS, Severna Park, MD
Executive VP: Lee McLamb, KU4OS, Cocoa, FL
VP Operations: Drew Glasbrenner, KO4MA, New Port Richey, FL
VP Engineering: Bob McGwier, N4HY, East Windsor, NJ
Secretary: Barry Baines, WD4ASW, Westborough, MA
Treasurer: Gunther Meisse, W8GSM, Mansfield, OH
Manager: Martha Saragovitz, Silver Spring, MD

A motion was made to accept list of candidates and the board voted 7-0 to appoint these senior officers.

AMSAT President Rick Hambly, W2GPS, introduced Dan Briner, AB3EN, of Canonsburg, PA who is being appointed VP-Marketing by the president. Dan has held marketing positions for various financial institutions and hospitals and is currently the Director-Information Technology for Washington County, PA.

President's Report for 2007

What is the core of the "Reality of the Future?" AMSAT's planned new missions will provide great new services to the ham community but

we cannot pay for them and no one outside of the AMSAT community will pay for 'toys' for us to play with (hams or not). Therefore, our future missions must excite new funding sources.

Education

- The AMSAT Institute will be started in conjunction with University of Maryland Eastern Shore (UMES) with students housed and taking classes at the university and working at the AMSAT lab. Rick has met with UMES and Hawk Space Institute who have agreed to the concept, but no work has been done to move this proposal forward. We need an outline of a curriculum before December to have a program functioning in the summer of 2008.

Emergency Communications

-Phase-IV geosynchronous satellite

-Advanced Communications Payload

These types of payloads would be of interest to the US Government and perhaps help fund them.

Phase IV: AMSAT is negotiating with INTELSAT (merged with PANAMSAT) to place a package on one of their satellites. AMSAT proposed that a press release be jointly developed with INTELSAT announcing the discussions taking place. Intelsat rejected a press release but indicated that AMSAT could make an announcement at Symposium and that they could 'confirm' if asked.

AMSAT will not defer development of the Eagle or Phase 3-E satellites due to this potential opportunity.

Attaboys: Lee McLamb, KU4OS, and John Klingelhoefter, WB4LNM, for developing this opportunity for AMSAT.

The meeting was temporarily suspended at 0933 EST and resumed at 0945.

Secretary's Report (Barry Baines, WD4ASW)

AMSAT Secretary Barry Baines, WD4ASW, had previously sent to the BOD draft minutes for each of the board meetings that took place since the October 2006 meeting in Foster City, CA. Barry asked that the board make any suggested modifications or approve them as written:

-The minutes of the October 2006 BoD meeting held in Foster City, CA were approved by a vote of 7-0. The motion to accept was made by Bob McGwier, N4HY, and seconded by Tom Clark, K3IO.

-Minutes of the November 2006 BoD meeting held by "TeamSpeak" were approved by a vote of 7-0. The motion to accept was made by Rick Hambly and seconded by Gunther Meisse. Board approved 7-0.

-The revised minutes of the December 2006 meeting, held by teleconference, were approved by a vote of 7-0.

-Minutes of the March 2007 meeting held by teleconference were approved by a vote of 7-0. The motion to accept was made by Rick Hambly



and it was seconded by Bob McGwire.

-Minutes of the May 2007 meeting were approved by a vote of 7-0. The motion to accept was made by Rick Hambly and it was seconded by Gunther Meisse..

-Minutes of the June 2007 meeting were approved by a vote of 7-0. The motion to accept was made by Rick Hambly and the second was provided by Gunther Meisse.

These minutes will be sent to the Editor of *The AMSAT Journal* for publication.

Treasurer's Report (Gunther Meisse, W8GSM)

In 2007, the AMSAT accounting system was changed to QuickBooks. Martha made the change with assistance from the accountants. AMSAT transitioned from the old 'ACCPAC' software to QuickBooks with a portion of the year running both programs.

A motion was made by Tom Clark, K3IO, to accept the 2006 Financial Reports. Motion was seconded by Bob McGwier, N4HY. Board approved 7-0.

Auditors: Motion made by Bob McGwier, N4HY, and seconded by Tom Clark, K3IO, to hire the same auditing firm for year 2007 and to perform the 2007 audit to take place in 2008 as was used in 2006 (Berlin, Ramos & Company, P.A.). The Board approved the motion 7-0.

Endowment Fund: The BOD previously established the Endowment Fund for fund raising purposes. Motion was made Rick Hambly, W2GPS, to accept a name change to include the word 'Foundation' (e.g. AMSAT Foundation & Endowment Fund) and to change the name in all relevant documents. Motion was seconded by Bob McGwier, N4HY. The Board approved the motion 7-0.

National Fundraising: The Goettler National Fundraising initiative is being held in abeyance until the Phase IV Intelsat opportunity and the AMSAT Institute proposal mature sufficiently that they can be highlighted in our National Fundraising efforts.

Combined Federal Campaign (CFC): AMSAT missed the deadline for 2007 application. Consequently, AMSAT will not receive about \$5,000.00 in donations for the 2007 campaign.

AMSAT Information Management System (AIMS): The Development Committee worked hard with suggestions on what elements are needed. The team achieved an agreement in what would be put in the system and Emily, N1DID, developed a prototype. We need to transition this to a new developer. Gunther Meisse, W8GSM, wants to get AIMS operational in 2008.

AMSAT's loan to TAPR (Tucson Amateur Packet Radio) for HPSDR (High Performance Software Defined Radio) development is due to be repaid by 31 Dec 07. AMSAT may offer another loan in 2008 in support of HPSDR activities.

ARISS - Human Spaceflight

Frank Bauer, KA3HDO, Director, Human Space

Flight was not available during this discussion. Instead, Rick Hambly, W2GPS, and Lou McFadin, W5DID, provided some insight.

AMSAT President Rick Hambly, W2GPS, announced that he has appointed Dr. Stefan Wagner, VE4NSA, as Robin Haighton's replacement. Stefan is involved with a CubeSat project at the University of Manitoba. He will be at the BOD meeting tomorrow (Friday) to introduce himself.

Lou McFadin: Suitsat-2 is going slowly. The plan needs to be approved by Russian Space Agency while the agency is undergoing changes. We had hoped to get this on the International Space Station by October 2007, but now it looks more like October 2008.

ARISS: The Team wants to send up an HF Radio, but that is now on hold due to limits on upload mass. NASA's position is that if an item is not 'critical', it won't be launched. ARISS also wants to send up a switching box for connection to the one power outlet to which we have access.

Manager's Report (Martha Saragovitz)

One of the biggest functions is interacting with all of you - getting things done. For example, getting Tom Clark, K3IO, to write the fund raising material.

Martha recruited Emily, N1DID, to take on *The AMSAT Journal* CDROM project to replace someone who got to a certain point in the project and couldn't complete it. Emily did a great job in getting it done.

The Board meeting was suspended at 1119 and resumed at 1125.

Executive VP Report (Lee McLamb, KU4OS)

Education: AMSAT Director, Education, Paul Shuch, N6TX, sent an e-mail concerning American Student Lunar Orbital group. AMSAT is pretty well tapped for resources. He doesn't see us agreeing to resources, but if particular AMSAT volunteers wish to donate time, that is okay.

Paul is writing columns for *The AMSAT Journal* that also appear in *CQ/VHF Magazine*. He has attended various meetings. Has not been kept in the loop concerning the AMSAT Institute. He will continue to serve as Director, Education. We don't yet have a defined educational program.

AMSAT's focus on education will be a centralized activity at a specific location: AMSAT Institute.

Government & Regulation: FCC Reconsideration Petition

International Bureau R&O in before Register, they withdrew orbital debris and have it as a separate matter.

Wireless Bureau: AMSAT was not as fast in our submission. We did not get petition submitted until regulations were published. Subsequent meeting with FCC 'on the record' held in Washington. Orbital Debris Mitigation is now 'in force'.

University 'Nanosat' program under USAF and NASA (60cm x 80cm cylinder) has a design goal

of meeting the newest 'orbital debris' regulations. The satellite needs to be out of orbit within 25 years. Having an Amateur Radio station on board fits better into the regulations in terms of length of life vs. mission life.

FCC has no problems with High Earth Orbit (HEO) missions. The real issue is the many CubeSats planned for 'prime value' near sun synchronous orbits. The FCC is now receiving orbital debris mitigation reports, but it is not clear what FCC is doing with them. The FCC has reinstated the 27-month notification rule for upcoming launches to 'review the plan'.

International Relations: Robin, VE3FRH, has resigned as AMSAT's VP-International. This is now an open position. It may not be filled as most interaction is President-to-President. Rick Hambly, W2GPS, will start to manage the AMSAT-International mailing list. AMSAT-FR wants to join.

The BOD broke for lunch at 1215 and reconvened at 1300.

Operations Report (Drew Glasbrenner, KO4MA)

AO-51 is going well. The Operations Committee continues to schedule a variety of modes.

A decision made last December to drop the PL requirement has resulted in more throughput and better operator behavior.

See Ops report for more details

AO-7: Working well.

Marketing & Sales (Dan Briner, AB3EN)

Marketing's First Tasks:

- Review and refinement of the AMSAT logo and its use
- Redesign the nametags and other items using the logo
- Look at AMSAT communications
- Review each of AMSAT's projects with the associated leaders to determine what Marketing can do to help.

User Services (Gould Smith, WA4SXM)

AMSAT Journal (Ed Long, WA4SWJ is the editor)

Lack of content makes issues late. Ed needs content by 15th of odd month. Gould asked for articles 3 times per year from each department.

2008 AMSAT Journal Goals

- Each board member and officer to write at least three articles per year
- Recruit help for getting articles
- Recruit help to pre-process/write new articles
- Work with the new Marketing & Sales team to get more advertisements
- Get the Journal back on a more consistent delivery schedule

AMSAT News Service (ANS)

-Weekly AMSAT news and we're getting it out



in a timely manner.

Awards and Contests (under Bruce Paige, KK5DO)

For 2006 versus 2007:

Awards Issued:

Sat Communications Club: 25/17

Satellite Communication Achievement: 15/14

Sexagesimal: 0/5

Century: 0/0

South Africa 9/14

AMSAT Store

Nov-Oct Orders: 2213 (2007) vs 1119 (2006) and 1042 (2005)

2007 AMSAT Nets (under Keith Pugh, W5IU)

20 Meter AMSAT Net operates 1900Z on Sundays with pre-net warm-up at 1800Z. Keith, W5IU, and Larry, W7LB, are net control operators. The 20 meter net 'needs propagation assistance' as check-ins are declining due to difficulty in hearing check-ins.

Numerous VHF/UHF Nets: currently confirming these and updating Web site. The new Florida Net has been very successful.

Field Operations Activities

- Conduct local and regional nets
- Answer questions via telephone or e-mail
- Provide articles for local newsletter and AMSAT publications
- Provide technical review for AMSAT publications and the AMSAT Web site
- Involve schools with satellite projects

AMSAT Area Coordinators

2007: 180 vs. 179 in 2006. Regional Coordinators are keeping track of who is active within their region.

Hamfest participation (not including Dayton Hamvention): 47 hamfests generating \$12,193 in 2007 vs. 49 hamfests generating \$13,260.00 in 2006. Gould has asked each area coordinator to do one activity each year, such as a club presentation, hamfest, etc.

2008 Field Operations Goals

- Increase hamfest process
- Improve use of FOSS (Field Operations Support System)
- Organize a list of skills and who to call when area coordinators have questions
- Increase the number of presentations/demonstrations given
- Improve hamfest revenues
- Increase the activity level of currently inactive Area Coordinators and recruit new, active area coordinators

Gould outlined plans for the 2008 Dayton Hamvention. Dayton revenues in 2007 were \$21,395 vs. 28,159 in 2006.

LVB Tracker Box offered by AMSAT (developed by Howard Long, G6LVB)

- Finished cabinet is now available
- Does tracking only, no radio tuning
- \$200 assembled & tested from AMSAT

50 boxes to be made at a batch w/35 orders received. Sold 70 boards at Dayton.

Meeting suspended at 1510 and resumed at 1525

VP Engineering Report (Bob McGwier, N4HY)

Accomplishments

- 2007 not a great year - lack of progress
- 70 cm receiver prototype is built and under test by Juan Rivera, still not 100%
- CAN-Do modules are a RF source and need rework due to switching power supply. Modifications are needed because our low power UHF receiver forces the power supply into a mode that shifts the output of the switching frequency of the power supply into the passband of our baseband signal. This issue will not be a problem for P-3E.
- IHU-3 is not finished. AMSAT-DL needs it NOW.
- Marco, N2UO, delivered a prototype two-meter high efficiency amplifier and gets his paper accepted in "IEEE Transactions".
- Bob Davis, KF4KSS, gets us to the point of finishing the clean room and is close to getting a Certificate of Occupancy for the new AMSAT Integration Lab.
- Rapid prototyping development kits for the SDX (Software Defined Transponder) and ACP (Advanced Communications Package) are purchased and three AMSAT engineers are to go for training (Rick, Tom, Bob). We are using MATLAB, which is not open source, but provides a means to get our act together for Intelsat.
- AMSAT engineering receives a donation of Ansoft library (Antennas) and Sokal's Class E simulation code (see N2UO talk).
- Further paper design work is being done on ACP, no hardware design work done.
- Howard Long, G6LVB, is the only person doing SDX work in 2007 except for Suitsat-2.

AO-51: Jim White has the new AO-51 software developed and deployed. Jim has AMSAT's AO-16 computer, ICE Card (SCOS), AO-51 computer, reset code generator and DOVE-17 stuff. We may need these materials redeployed at some point.

Eagle Project Manager's Report (Jim Sanford, WB4GCS)

Eagle Project Manager Goals for 2007

My partial goals are:

- Prototype 70cm RX and 2m TX
- Demonstrate above, with some form of SDX prototype
- x-Demonstrate prototype IHU-3 and CAN widgets (integrated)
- Structure design and model
- Refine microwave phased array plans
- x-Peer review, test, demonstrate text messaging
- x-Begin development of integration plan and composite test plan
- Develop Work Breakdown Structure (WBS) leading to a preliminary development/construction structure
- Verify that 70 cm receiver Los are adequate for

text-mode uplinks (KD6OZH)
x-Build and test 2m/70cm antenna arrays
x-Prototype phased arrays

Note: 'x' above means not accomplished

Lab Report (Bob Davis, KF4KSS - given by Bob McGwier, N4HY)

CubeSat project-supported by Boeing has been taken on. Bob, N4HY, and Rick, W2GPS, participated in initial design review.

Goals for 2008

- Rapid prototype of SDX and ACP and production working software for both. G6LVB's work will be leveraged for DSP part of SDX, but the modulator FPGA work will be attempted as well. Small scale ACP to be done on Lyrtech as well as SDX modulator.
- Get the AMSAT Integration Lab up and running and get Certificate of Occupancy
- Work with Intelsat to understand their interface and documentation requirements
- HASP (High Altitude Student Payload) Balloon project (place Suitsat-2 suite on it? -to be launched from Texas). Transponder and ground station requirements (capital requests - \$9,000.00).
- Eagle budget request submitted by the Project Manager is removed and the replacement request has been given to the AMSAT Treasurer by VP - Engineering.
- Reorganization of engineering effort to accomplish Intelsat project requirements
- Finish IHU-3 build for AMSAT-DL
- Can-Do Redesign
- Help HISS (Hawk Institute for Space Sciences) with CubeSat to the extent possible because of their project manager departure for California job.
- Finish phased array prototype work.

In 2008, continue mechanical work on Eagle but postpone non-Intelsat related work (power, thermal, etc.).

If Intelsat says 'Yes' to AMSAT:

- A major upgrade in the design work must be done.
- It is the VP-Engineering's opinion that AMSAT cannot build a 15-year lifetime geostationary RF payload in 'our basement'. We are going to need to do contract manufacturing for this.
- Intelsat will NOT say 'yes' publicly until we sign a launch and satellite services contract. We will have to have our funding sources lined up.
- Simple computer needed, no real-time requirements. Robustness in environment is required.
- Intelsat thermal systems must be understood so we can build our flight hardware.

Meeting suspended at 1732 and resumed at 1743

Strategic Reports (Rick Hambly, W2GPS)

How is AMSAT doing vs. Mission & Vision?

The epiphany Rick has is that there are only two things that can raise substantial amounts of money: For Emergency Communications & Education.



ITAR and Technical Assistance Agreements (TAA)

-After a year of trying, the State Department has reissued our munitions license. They have accepted our back fees since the last time we registered.

-Technical Assistance Agreements—we have a volunteer lawyer who approached Rick at the 2007 TAPR/ARRL Digital Communications Conference. He has written a draft TAA that has been reviewed by outside lawyers 'pro bono'. As soon as they are ready, the TAA draft will be shared with BOD, AMSAT-DL and AMSAT-UK.

Eagle and Rideshare

- AMSAT will support development of those aspects that are common for 2008 plus build the Eagle space frame.

AMSAT Institute, UMES (University of Maryland, Eastern Shore), Hawk and AMSAT Lab

-The proposal is to bring students to the AMSAT Lab rather than trying to send mentors around the country.

- We have agreements in place with Hawk Institute and UMES. To succeed we need to move ahead with people dedicated to working on this.

BOD Meeting suspended at 1805 for dinner and resumed at 1847

AMSAT-DL/P3-E

A presentation was given by Hartmut Pasler, DL1YDD/N1PU, and VP, BOD Member AMSAT-DL

Background: in 2007, AMSAT-NA donated 30,000 Euros to keep P3-E going. AMSAT-UK gave 10,000 Euros.

"Greetings from AMSAT-DL"

Current P3-E Status

-Propellant tank qualified and integrated
-Batteries (main and auxiliary) qualified and ready for integration
-VHF/UHF/SHF antennas ready for integration
-Microwave antennas ready for integration
-Sun and earth sensors integrated
-Available CAN-DO Modules have been extensively tested and are to be distributed to module builders.
-Camp Band ready for integration
-Motor tested and ready for integration
-Helium body qualified and ready for integration
-Miscellaneous 'small' items (in sum important) integrated
-All mechanical work completed
Not yet ready: IHU (Integrated Housekeeping Unit)

Transponders

-UV, STELLA, SDX delayed but still on track
-LS: L-Frontend: OK, tweaked for minimum Galileo GPS interference
--S-TX; works in progress
--HELAPS: tests necessary

-P5A: Work in progress
-Coherent transponder (Finnish Group)

Launch Opportunities

AMSAT-DL has a serious offer from Arianespace on either Ariane or Soyuz. Additional contacts to Japan, Russia, India may offer cheaper launch alternatives, but there are other constraints.

Funding Efforts

-Attractiveness of Amateur Radio has dropped. Funding an HEO satellite from amateur resources alone never worked before and will not work now.

-Promotion from government: Application for DLR promotion of P5A mission.

-P3E will fly as an experimental test platform for P5A technology

Funding Application Made for P5A

20 million Euro (\$28mm US) consisting of 10 million Euros for launches of P3E and P5A and 10 million Euros for building P5A. Application already submitted to DLR with first meeting with high-ranked DLR officials very promising. The issue in the eyes of DLR is quality control of AMSAT-DL's projects. Fundamental funding decision is expected in late November 2007. If a positive decision, money will not flow to AMSAT-DL before mid-2008.

AMSAT-DL's problem: How to survive until mid-2008?

AMSAT-DL Funding

AMSAT-DL already has invested 300k Euros into P3-E and P-5A. AMSAT-DL has expenses of 40,000 to 60,000 Euros per year (rent of ZEL, pay for project manager, travel). Other Sources of Funding includes DARC (Deutschland Amateur Radio Club)-to be approved by DARC BOD, JARL, AMSAT-SM, AMSAT-CT, Dayton ARC, AMSAT-NA + AMSAT-UK. Last Friday, AMSAT-DL met with CEO and CTO of a well-known optical instruments company. Very promising result: We have been told that this company will basically engage in the P5A project, technical meeting and detailed discussions.

Current status of ZEL (AMSAT-DL's Lab) and consequences:

--University (Marburg) abandons ZEL
--Some people will retire from the University
--Some others will be dislocated within the University
--Lab lease contract already cancelled effective 12/31/07

AMSAT-DL will lease a subset of the ZEL rooms (1/3 of former space) for a lower rent. Short period of cancellation, flexible. AMSAT Integration Room is not affected by any university actions, but must be abandoned if AMSAT-DL leaves the building.

Potential future home for AMSAT-DL:

University of Stuttgart, Prof. Roser with a new Center of Space and Aerospace.

Problem: Completion of building is scheduled for the end of 2009 with AMSAT-DL planning

on transfer at the end of 2010. However, this is too late as the Mars launch window ends in 2011 for P5A. Consequently, at present the only viable option is to keep ZEL Alive!!

AMSAT-DL's Main Focus:

-Try to keep ZEL alive if possible
-Push DLR P5A promotion

The future of ZEL depends on Marburg KEY volunteers

-Horst Wagner (wiring harness) - already retired

-Ulrich Muller (now head of ZEL, retires end of 2007)

-Peter Oswald (mechanics) - will be relocated within university

-Heniz Molleken (layout + prototyping): May keep his office in ZEL, renting space from AMSAT

-Karl Meinzer

Employees

-Heike Straube (project manager P3E) - paid by AMSAT-DL

Future of P3E is dependent upon P5A

Asking for financial support from AMSAT-NA will greatly enhance probability of getting P3E into orbit soon. Looking for 25,000 Euros. Karl Meinzer is focused on P5A with P3E as a stepping-stone. If DLR turns down request for funds, then Karl will not be interested in P3E. AMSAT-DL is looking for \$27,000 from AMSAT-NA and approximately \$9,000 from AMSAT-UK.

As a result of Hartmut's presentation, a motion was made by Bob McGwier, N4HY, for AMSAT to donate to AMSAT-DL 19,000 Euros (x 1.425 is approximately \$27,000) to help complete P3E. Seconded by Rick Hambly, W2GPS.

Discussion:

If DLR turns down funding request and AMSAT-NA/UK gives the donation, the satellite will be finished and stored. If DLR turns down funding request and AMSAT-NA/UK does not give donation, then satellite will be stored in pieces and probably never completed. Completion includes thermal vacuum and other testing.

Question called: motion by Bob McGwier, N4HY, for AMSAT-NA to donate to AMSAT-DL 19,000 Euros (x 1.425 approximately \$27,000) to help complete P3E. Seconded by Rick Hambly, W2GPS. Following discussions, the motion was approved 6-0 with one member abstaining (Tom Clark, K3IO). AMSAT President Rick Hambly, W2GPS, will get with AMSAT-UK's Jim Heck to discuss development of a P3-E Operations Agreement.

The Board concluded the meeting at 2015 EST to reconvene at 0800 Friday, 26 OCT in closed session.

Friday, October 26, 2007

The AMSAT Board of Directors meeting reconvened at 0810 Friday morning, 26 Oct 07 at the Airport Marriott Hotel, Corapolis, PA in **closed**



session. All board members were present. The first item on the agenda was AMSAT Manager Martha Saragovitz's compensation review. Following discussion, Martha Saragovitz was invited to the meeting to be advised by AMSAT President Rick Hambly, W2GPS, of her 2008 compensation package and to provide her with feedback from Board Members on her 2007 Performance Review.

ITAR

Continuing in closed session, the Board discussed ITAR (International Traffic in Arms Regulations) and invited the following to participate:

-Bill Tynan, W3XO (Former AMSAT President)

-Robin Haighton, VE3FRH (Former AMSAT President)

-Jim Sanford, WB4GCS (Eagle Project Manager)

ITAR applies to AMSAT because satellites are considered to be 'armaments' and AMSAT is considered to be an 'arms dealer.' An overview was provided by AMSAT President Rick Hambly, W2GPS, of the steps being taken by AMSAT to draft Technical Assistance Agreements (TAA) required by ITAR for distribution to our foreign partners involved with our satellite projects.

Following discussion of ITAR, the Board then went into **open** session.

ARISS-Canada

As noted during Thursday's Board Meeting, Robin Haighton, VE3FRH, has resigned as ARISS-Canada representative. He has recommended Dr. Stefan Wagner, VE4NSA, to replace him. Stefan introduced himself to the board members.

AMSAT-UK Report

Jim Heck, G3WGM, Honorary Secretary of AMSAT-UK provided an overview of AMSAT-UK to the AMSAT Board. Graham Shirville, G3VZV, AMSAT-UK Committed provided an overview of several AMSAT-UK projects.

Graham posed the question, "Will AMSAT-NA endorse AMSAT-UK's support for putting satellite frequencies in the 144.000/.035 MHz EME?" According to Graham, this allocation is globally harmonized but largely neglected since 144.100+ MHz is now in greater use. This proposed allocation could be used for 35 kHz transponder for CubeSats.

AMSAT-NA BOD will take this question under advisement.

2008 AMSAT Symposium

Martha Saragovitz reported that she had called Robin Cutshaw, AA4RC. He has agreed to do the Symposium in Atlanta, GA. Robin coordinated the Southeast VHF Society Convention in 2007. A motion was made by Tom Clark, K3IO, to accept

Robin Cutshaw's (AA4RC) proposal to hold the 2008 Symposium in the greater Atlanta, GA metro area. Bob McGwier, N4HY, seconded motion. Motion carried 7-0.

2008 Budget Discussion

P3-E money voted yesterday will be in the 2007 budget. Doesn't show in 2008.

VP-Engineering capital requests: approximately \$50,000.00. A motion was made by Gunther Meisse, W8GSM, and seconded by Tom Clark, K3IO, to accept the 2008 Rev. 5.0 as amended proposed budget. Motion carried 7-0.

Atlanta Symposium

Following the earlier decision by the BOD to hold the 2008 AMSAT Symposium in Atlanta, Robin Cutshaw, AA4RC, made some comments to the Board of Directors.

Harry Yoneda, JA1ANG

Tom Clark, K3IO, noted that AMSAT lost Harry Yoneda, JA1ANG, SK on 8 OCT 07. Harry spent his younger youth in the UK, returning to Japan during World War Two. His professional career was as special assistant to President of DENTSU serving as translator.

Attaboys

Tom Clark, K3IO, had two 'attaboys':

1. Rick Hambly, W2GPS, had a trying year and the outlook for AMSAT's future is good.
2. John Klingelhoefter, WB4LMN, retired as CEO and President of Intelsat General, a subsidiary of Intelsat. He has played a pivotal role in the Intelsat discussions.

A suggestion was made by Gunther Meisse, W8GSM, to designate next year's Symposium: "AMSAT Yoneda Memorial 2008 Space Symposium" Voice approval made by the Board (actual vote not taken).

Rick Hambly, W2GPS:

-Thanks to the executive team.

-Lee McLamb, KU4OS: Thank you for recognizing what is important at the Small Satellite Conference and opened the door to what could be the greatest opportunity for Amateur Radio (Intelsat proposal).

Drew Glasbrenner, KO4MA: AO-51 support by Gould Smith, WA4SXM.

Bob McGwier, N4HY:

-Thanks to James Miller for providing names/dates for captioned photos in the AMSAT archives regarding P3D development.

-Keith Pugh, W5IU, for the AMSAT Net and ARISS contacts.

Tom Clark, K3IO: Thanks to the Eagle Development Team

-Juan Rivera, WA6HTP, Bay Area, extremely new valuable resource—fabrication of an Eagle module

-Dick Jansson, KB1K: Eagle's nudge on all things mechanical.

-Bob Davis, KF4KSS, for work done on buildup of lab in Pocomoke.

-Mark Franco, N2UO, not here due to wife expecting.

Represents new young blood for the organization. He has competency on high power transmitters that we lacked in the past.

-John Stevenson, KD6OZH: 70 cm receiver design.

-Lyle Johnson, Chuck Green-good strong technical folks.

-Mark Raptis, KF6WTN, and Bob Reents solved the configuration problem on the SuitSat-2 SDX with the A/D D/A chip and how to get beyond a serious problem in setting the CPU clock.

Following the 'Attaboys', Giulio Pezzi, IZ4FVW-AB2VY, of Italy gave an introduction of himself and overview of his presentation on "ALMASat Microsatellite Platform for Small Scientific Experiments in Orbit."

Motion to end the BOD meeting made at 1154 by Gunther Meisse, W8GSM, seconded by Barry Baines, WD4ASW. Motion passed 7-0.

Respectfully Submitted,
Barry A. Baines, WD4ASW
Corporate Secretary



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